The American Journal of Obstetrics and Gynecology

VOL. XII ST. LOUIS, OCTOBER, 1926 No. 4

The American Gynecological Society 1876-1926

Semicentennial Meeting and Anniversary Dinner*
Stockbridge, Mass.
May 20, 21, and 22, 1926

Original Communications

ENDOMETRIOSIS OF THE SAC OF A RIGHT INGUINAL HERNIA, ASSOCIATED WITH A PELVIC PERITONEAL ENDOMETRIOSIS AND AN ENDOMETRIAL CYST OF THE OVARY†

BY JOHN A. SAMPSON, M.D., ALBANY, N. Y.

(From the Gynecological and Pathological Departments of the Albany Hospital and the Albany Medical College)

IN RECENT years we have acquired many interesting facts, near facts and fancies in regard to the structure, activity and origin of benign ectopic endometrial tissue. We have learned that this tissue presents the same variations in structure as the mucosa lining the uterine cavity and that it is often governed by the same natural laws as the latter in its reaction to menstruation, pregnancy and the menopause. We have also learned that just as endometrial carcinoma invades the uterine wall so at times may benign endometrium do the same, the latter giving rise to a direct or primary uterine endometriosis, the so-called adenomyoma of mucosal origin or adenomyosis uteri interna.

The experimental work of Stilling,[1] Loeb[2] and others has shown that bits of uterine tissue of the lower animals may be transplanted to other

*The addresses delivered at the Anniversary Dinner will be published in the special volume of the Society Transactions.

†Presented at the Fifty-first Annual Meeting of the American Gynecological Society, Stockbridge, Mass., May 22, 1926.

NOTE: The Editor accepts no responsibility for the views and statements of authors as published in their "Original Communications."

parts of the body of the same animal and there grow. The incidence of endometrial tissue in the scar of the abdominal incision after cesarean section and other pelvic operations in which it was possible to have contaminated the abdominal wound with fragments of endometrial or tubal tissue indicates or at least suggests, that under favorable circumstances this tissue may be unintentionally but successfully transplanted by the surgeon in human beings.

The experimental work of Jacobson[3] and others, especially the work of the former on monkeys, demonstrates that bits of uterine mucosa scattered in the pelvic cavities of these animals may give rise to peritoneal implantations of this tissue, resembling the lesions of peritoneal endometriosis in women. We know that fragments of endometrial tissue sometimes escape into the peritoneal cavity with a back flow of blood through the tubes from the uterine cavity during menstruation, from the rupture or perforation of an endometrial cyst of the ovary, and possibly from the menstrual reaction of endometrial tissue on the peritoneal surface of the various pelvic organs and structures. It would seem natural to believe that under favorable circumstances this endometrial tissue might become implanted on the peritoneum and there grow giving rise to the endometrial tissue in the lesions of peritoneal endometriosis just as similar lesions arise in experimental peritoneal endometriosis in the lower animals and as cancer becomes implanted on the peritoneum in peritoneal carcinosis.

I have observed bits of endometrial tissue in the venous sinuses and possibly the lymphatics of the uterine wall in patients operated upon

---

Fig. 1.—Peritoneal endometriosis in the posterior culdesac obliterating the bottom of the culdesac by fusing the anterior wall of the rectum to the posterior wall of the cervix uteri (natural size, from colored sketch made at the operation). The patient was thirty-seven years old and single; the uterus was retroflexed, both tubes were patent, and the induration in the culdesac, caused by endometriosis, was easily detected prior to the operation. A similar lesion in a hernia sac might constrict or occlude the lumen of its neck, as shown in Fig. 6.

Fig. 2.—Peritoneal endometriosis about subserous leiomyomas in the anterior wall of the uterus (natural size). Adhesions resulting from the peritoneal reaction are present and a hematoma, possibly of endometrial origin, has developed in these. The patient, aged forty-six years, has a multinodular myomatous uterus. An extensive peritoneal endometriosis was present with lesions in the right ovary, on the posterior and anterior surfaces of the uterus and in the posterior culdesac. (See Figs. 7 to 12 inclusive.) Both tubes appeared normal and patent. The hematomas in the hernia sac shown in Fig. 6 might have had an origin similar to the one in this illustration.

Fig. 3.—Under surface of the right ovary (Fig. 14) showing pigmentation apparently due to the incomplete absorption of blood (natural size). For the histology of this lesion see Fig. 16. Endometrial tissue was not found in the ovary.

Fig. 4.—Appearance of the peritoneal lesions of the anterior culdesac (natural size), Fig. 13. The pigmentation is in part due to the incomplete absorption of blood (see Fig. 17). Endometrial tissue was found in some of these lesions (see Figs. 17 and 20).

Fig. 5.—Appearance of the peritoneal lesion in the posterior culdesac (natural size) Fig. 14. It apparently represents a later stage of the process shown in Fig. 4. For its histologic structure see Fig. 22.

Fig. 6.—Endometriosis in a hernia sac (natural size). The entire sac including its neck and part of the intraabdominal portion of the round ligament were removed in one piece. The sac has been opened down to its neck. The abdominal opening *E* is constricted by the peritoneal endometriosis in this situation, similar to the condition shown in Fig. 1. The "arrow" indicates the course of the lumen of the neck of the sac which was obliterated (or nearly so) by the reaction associated with endometrial tissue in its walls (Figs. 25 to 30). Two pedunculated hematomas (*h*) apparently arising in adhesions are present and are possibly of endometrial origin (Figs. 31 to 33), as was the one shown in Fig. 2. The endometrial lesions in the sac (including its neck) are similar to those shown in Figs. 1 and 2.

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

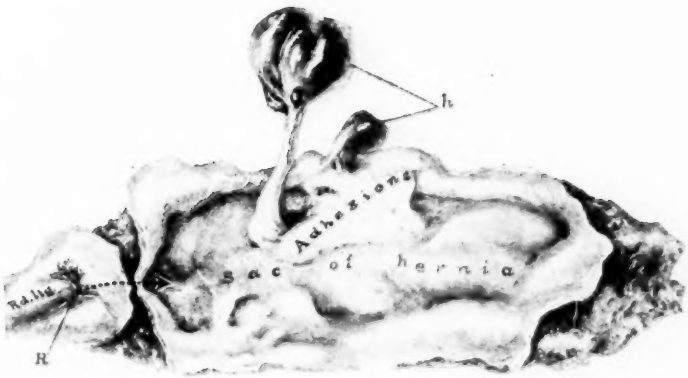

FIG. 6

PLATE I

during the menstrual period. Realizing the activity of this tissue and the fact that it may grow when transplanted in favorable soil we believe that possibly metastasis may occur through these channels. There are then many indications that the invasion and dissemination of benign endometrial tissue at times follows the same channels as carcinoma and chorioepithelioma.

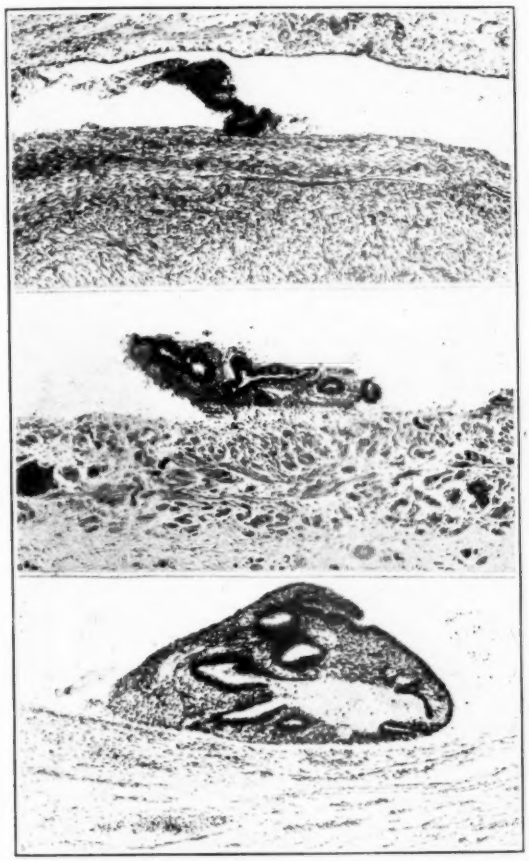

Fig. 7.—Three photomicrographs (x 60) of implantation-like lesions of endometrial tissue growing upon the surface of the right ovary, tube, and upon adhesions (case shown in Fig. 2). Their histologic structure is identical with that of the uterine mucosa. Do they represent an implantation of endometrial tissue or a metaplasia of the peritoneal mesothelium? I believe the former.

Pelvic peritoneal endometriosis therefore represents but one phase of heterotopic or disseminated endometrial tissue just as peritoneal carcinosis secondary to cancer of the pelvic organs, represents only one phase of heterotopic or disseminated cancer. Peritoneal endometriosis may be defined as implantation-like peritoneal lesions developing in women during their menstrual life and usually occurring in situations easily reached by material escaping into the peritoneal cavity from the tubes, ovaries or other pelvic structures. These lesions are characterized by

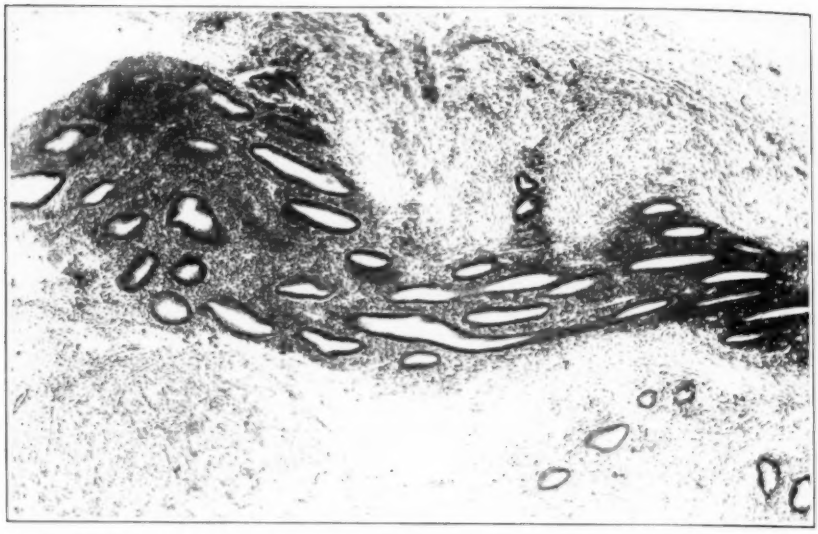

Fig. 8.—Photomicrograph (x 60) of endometrial tissue apparently invading the right ovary (case shown in Fig. 2). The condition present has arisen from two processes: one is the actual invasion of the ovary by the endometrial tissue, and the second, and probably the more active one, is the growth of the tissues of the ovary over the endometrial tissue upon its surface, thus enveloping it.

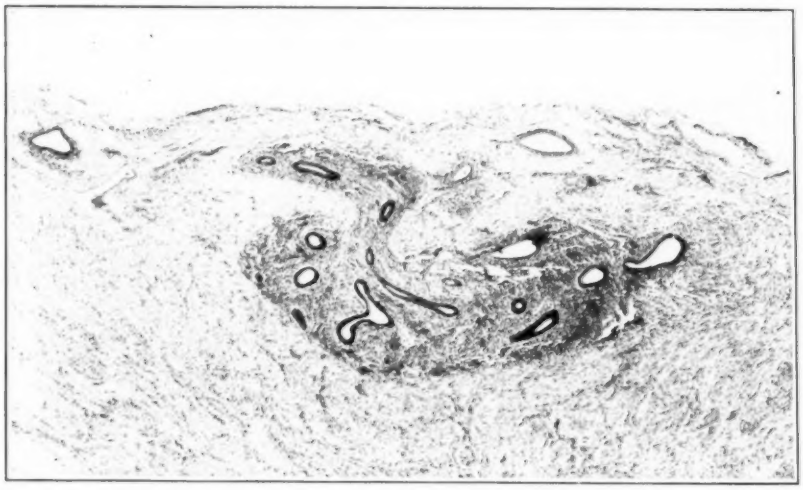

Fig. 9.—Photomicrograph (x 25) of endometrial tissue in the posterior uterine wall near its peritoneal surface (case shown in Fig. 2). As in the lesion shown in Fig. 8, the present condition probably arose from endometrial tissue deposited or developing upon the posterior surface of the uterus and the subsequent invasion of that organ by it and also the growth of the tissues of the uterus over it.

the well-known results of peritoneal irritation such as granulation and scar tissue, adhesions and various peritoneal inclusions and in addition by the presence of endometrial tissue either on the surface of or embedded in these lesions, bearing the same relation to them as does cancer in peritoneal carcinosis and like the latter at times invading underlying structures.

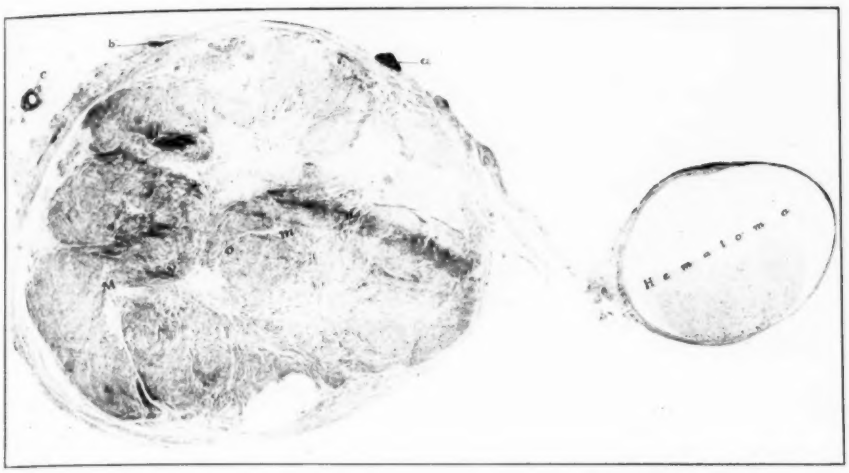

Fig. 10.—Photomicrograph (x 5) of a section through one of the subserous leiomyomas covered with adhesions and the hematoma in these adhesions (Fig. 2). Implantation-like lesions of endometrial tissue are present upon the surface of and imbedded in the adhesions; *a* (see Fig. 7), *b* (see Fig. 11), and *c* (see Fig. 12). The hematoma is lined by low to cuboidal epithelium-like cells and its contents consist of blood and phagocytic cells containing blood pigment. It is impossible definitely to state its origin. It might be an endometrial hematoma, and may have arisen from the accumulation of menstrual blood in a cavity similar to that shown in Fig. 11 or it might be a hemorrhagic peritoneal cyst. The hematomas shown in Fig. 6 might have had a similar origin.

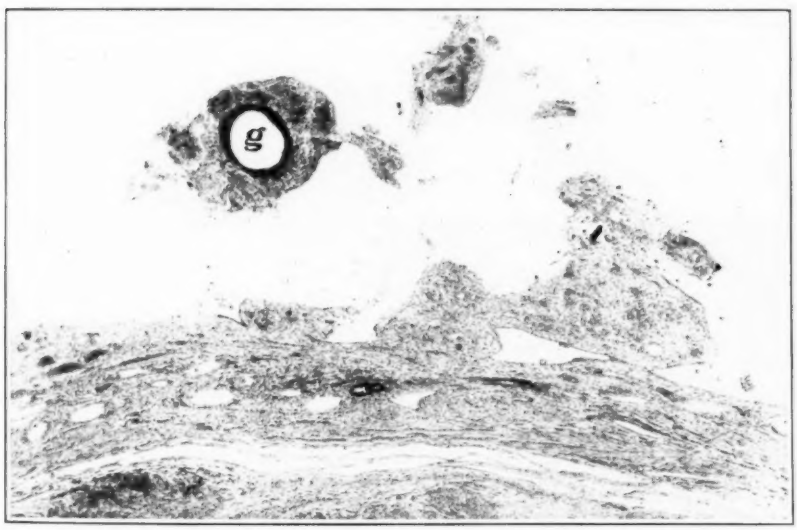

Fig. 11.—Photomicrograph (x 25) of the adhesions about the subserous leiomyoma shown in Fig. 11 (*c*). The adhesions are similar to those resulting from other peritoneal irritants and, in addition, a dilated gland-like structure (*g*) is present in the tip of one of the adhesions. Its histology is similar to that of a dilated uterine gland. It is lined by cuboidal epithelium-like cells with hemorrhage into the stroma about them. This stroma resembles atypical endometrial stroma. Should the blood about the dilated gland rupture into its lumen (as well it might) a hematoma would develop similar to those shown in Figs. 2 and 10 and Figs. 6 and 31.

The study of the distribution of the lesions of early pelvic peritoneal endometriosis at the time of operation demonstrates that they apparently consist of material escaping from the tubes or ovaries into the peritoneal

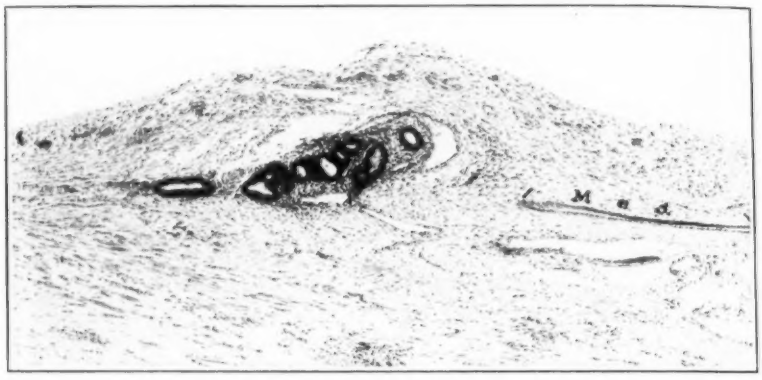

Fig. 12.—Photomicrograph (x 60) of adhesions about the subserous leiomyoma shown in Fig. 11 (*b*). Endometrial tissue is shown imbedded in the adhesions and protruding into a space lined by flattened cells, possibly a lymphatic, but more likely a dilated venous capillary. A definite inclusion of the peritoneal mesothelium is shown at *Mes*.

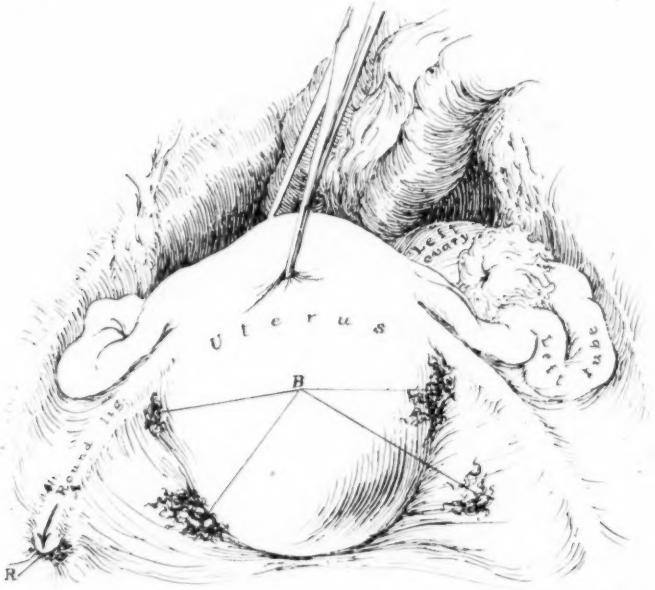

Fig. 13.—Peritoneal endometriosis associated with an endometrial cyst of the left ovary and an inguinal hernia. View of the pelvic contents showing the distribution of the lesions in the anterior culdesac (x $\frac{3}{4}$). Pigmented scars (*B*) are present in the normal depressions of the culdesac and also in the peritoneum about the abdominal opening of the hernia (*R*). The gross appearance of one of the peritoneal scars is shown in Fig. 4 and its histologic structure in Figs. 17 and 20.

cavity and the local reaction against the same. Four possible sources of this "material" suggest themselves.

1. Bacterial infection. The histologic study of the lesions of pelvic peritonitis convinces me that this is not a cause. Furthermore, one of

the outstanding features of patients with peritoneal endometriosis is that the tubes are usually patent. It would seem that salpingitis occurring in the first half of the menstrual life of women lessens the incidence of peritoneal endometriosis in later years.

2. Ovulation permitting fragments of ovarian tissue to escape into the pelvis. I believe that possibly this tissue may at times become implanted on the peritoneum and there grow but I doubt its ability to form tissue with the structure of the uterine mucosa.

Fig. 14.—View of the pelvic contents showing the distribution of the lesions in the posterior culdesac (x $\frac{3}{4}$) same case as Fig. 13. The cystic left ovary, which was adherent by its under and lateral surfaces to the posterior layer of the left broad ligament, has been freed and lifted out of the pelvic cavity. The uterus is drawn upward and forward. The left ovary is also shown in cross section. For the histologic structure of the walls of the endometrial cyst or hematoma of the left ovary see Figs. 15, 18, and 19. Recent-appearing pigmented lesions are present upon the under surface of the right ovary and upon the adjacent posterior surface of the uterus (*B-B*). Older lesions are present in the bottom of the culdesac and on the right uterosacral ligament (*End.*). The gross appearance of the lesions upon the right ovary and in the culdesac are shown in Figs. 3 and 5, and their histologic structure in Figs. 16 and 22. The distribution and character of the peritoneal lesions in this case indicates or at least suggests that they represent the local reaction to blood escaping into the pelvis either from the perforation of the endometrial cyst of the left ovary or from the tubes (which appear normal and patent) or from both of these sources.

3. The menstrual reaction of endometrial tissue on the surface of the ovary and the rupture or perforation of an endometrial cyst or hematoma of the ovary. A study of those cases has convinced me that peritoneal endometriosis does arise from this source but as peritoneal lesions may be present without any demonstrable endometrial tissue in the ovaries we must conclude that the latter cannot be the only cause of peritoneal endometriosis. We, therefore, must look for an additional means by which menstrual blood may gain access to the peritoneal cavity.

4. Menstrual blood escaping through the tubes as a back flow from the uterine cavity and from the tubal mucosa. In 257 cases of peritoneal endometriosis, encountered the last four years, both tubes appeared to be patent in 250, a unilateral hematosalpinx was present in one (other tube patent), bilateral hematosalpinx in four and bilateral pyosalpinx in two. Patent tubes apparently increase the incidence of peritoneal endometriosis and possibly the relatively large number of patients with hematosalpinx (five) may be of some significance. In all six cases with occlusion of both tubes the peritoneal lesions might have been present before the tubes were closed. A translation of these findings might read that during the menstrual life of women some substance escapes through the tubes into the peritoneal cavity which plays an important rôle in the etiology of pelvic peritoneal endometriosis, including the development of endometrial tissue in the ovaries. We have noted that peritoneal endometriosis apparently arises from the escape of the contents of endometrial cysts of the ovary into the pelvic cavity and from the menstrual reaction of endometrial tissue on the surface of that organ. Therefore it would seem that menstrual blood from any source might be a cause of pelvic peritoneal endometriosis. The distribution of the pelvic peritoneal lesions in the early cases is often such as to indicate their origin from material escaping through the tubes as well shown in the case reported

Fig. 15.—Colored photomicrograph (x 60) of a portion of the wall of the endometrial cyst of the left ovary (Fig. 14). In the right half of the photomicrograph the epithelial lining is still present while in the left half it is absent. The pigmented phagocytic cells, which constitute a large portion of the lining of the cyst, represent the attempt of the ovarian tissue to take up (absorb) the blood (menstrual) in its tissues and cavity. In other portions of the cyst wall typical uterine mucosa was present (Figs. 18 and 19).

Fig. 16.—Colored photomicrograph (x 60) of the pigmented lesion upon the right ovary (Figs. 3 and 14). Granulation tissue containing pigmented phagocytic cells, similar to those shown in Fig. 15, has developed upon the surface of the ovary and has arched over and included portions of the surface epithelium (*S. S.*). I believe it represents a reaction to blood deposited upon the surface of the ovary and the incomplete absorption of this blood. A similar reaction (without the blood pigment) may arise from any irritant, and, should a foreign body, such as a piece of silk thread, a bit of cancer or endometrial tissue, lodge upon the surface of the ovary, this foreign body might be enveloped by granulation tissue just as the surface epithelium is in this illustration. Endometrial tissue was not found in the lesions of this ovary.

Fig. 17.—Colored photomicrograph (x 60) of the pigmented peritoneal lesion shown in Fig. 4 and in Fig. 13. The vascular, newly-formed connective tissue upon the surface contains phagocytic pigmented cells similar to those shown in the two preceding illustrations. I believe it represents a later stage of the condition shown in Fig. 16. Deeper in the uterine wall is a space containing and lined by tissue of the structure of the uterine mucosa. A small amount of blood is present in this "endometrial cavity." Should a large amount accumulate a hematoma would be formed as in Fig. 21. For photomicrographs suggesting the development of this lesion see Fig. 20.

FIG. 15

FIG. 16

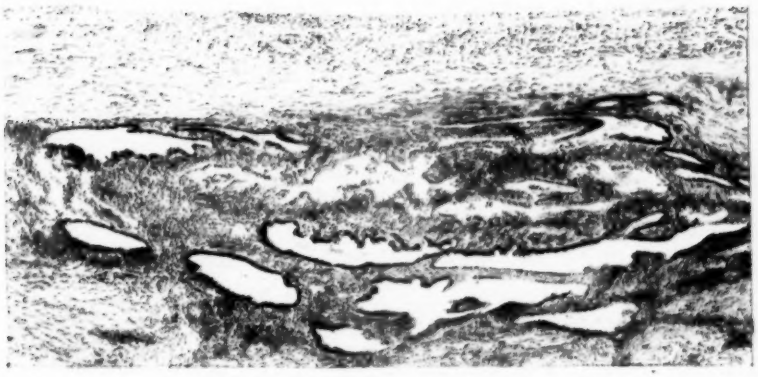

FIG. 17

PLATE II

STATE OF MICH

by Davis at this meeting. Phagocytic cells containing blood pigment are often present in the peritoneal reactions associated with peritoneal endometriosis. The distribution of these phagocytic cells often indicates that the blood did not necessarily arise from menstruation of the endometrial tissue in these lesions. Blood is occasionally observed escaping from the tubes of patients operated upon during their menstrual period. Why should not this blood be considered an equally efficient factor in the etiology of pelvic peritoneal endometriosis as that arising from endometrial tissue in the ovary?

From this indirect and direct evidence I have concluded that menstrual blood escaping into the peritoneal cavity by any route, as through the tubes, from the perforation of an endometrial cyst of the ovary or from the menstrual reaction of endometrial tissue on the peritoneal surface of any pelvic structure, may at least be a frequent cause of the lesions in pelvic peritoneal endometriosis. Also, the endometrial tissue in these lesions results either from the implantation and growth of frag-

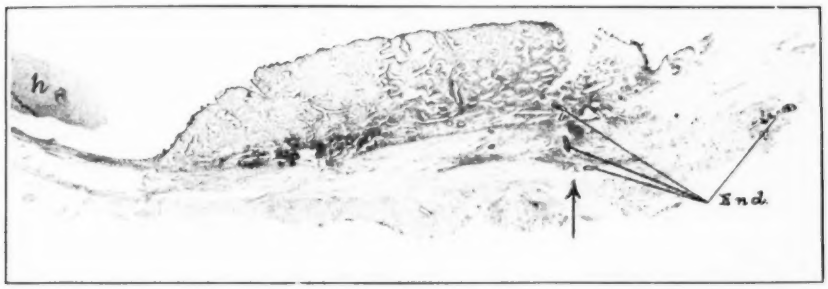

Fig. 18.—Photomicrograph (x 10) of a portion of the wall of the endometrial cyst of the left ovary, which was firmly adherent to the posterior layer of the broad ligament. A patch of typical "uterine mucosa" (see Fig. 19) is present, the surface epithelium of which is continuous with the epithelium lining the less typical endometrial portions of the cyst. The wall of the cyst is relatively thick in the right half of the section due to portions of the broad ligament which are fused with it and which were removed with the cyst. Glands (*End.*) of endometrial type are present in this tissue and these can be traced through the wall of the cyst into the uterine mucosa lining its cavity (see arrow and also Fig. 19). The fusion of this portion of the cyst wall with the posterior layer of the broad ligament must have arisen from the reaction either to the contents of the cyst escaping through a perforation of the latter or to an irritant from another source causing or associated with the endometriosis in this situation.

ments of endometrial tissue, which we know are sometimes present in menstrual blood, or else in some magical and mysterious way menstrual blood converts the peritoneum into tissue with the structure of the uterine mucosa. The endometrial lesions of peritoneal endometriosis do not arise in all portions of the peritoneum soiled by menstrual blood as indicated by scar-like areas containing blood pigment, some with and others without demonstrable endometrial tissue. We must therefore conclude that if the endometrium in these lesions arises from the stimulation of peritoneal mesothelium by menstrual blood, either there must be a solid element in this blood which acts as a specific irritant to the mesothelium, or else there are scattered throughout the pelvic peritoneum

areas of potential müllerian tissue which under the specific action of menstrual blood develop into endometrial tissue. The lesions are most frequently found in the dependent portions of the pelvis and in its natural folds and pockets. Their distribution, therefore, would seem to depend more upon gravity and other physical factors than upon the presence of areas of dormant endometrial tissue scattered throughout the pelvic peritoneum and in the serosa covering the various organs and structures which may be in the pelvis.

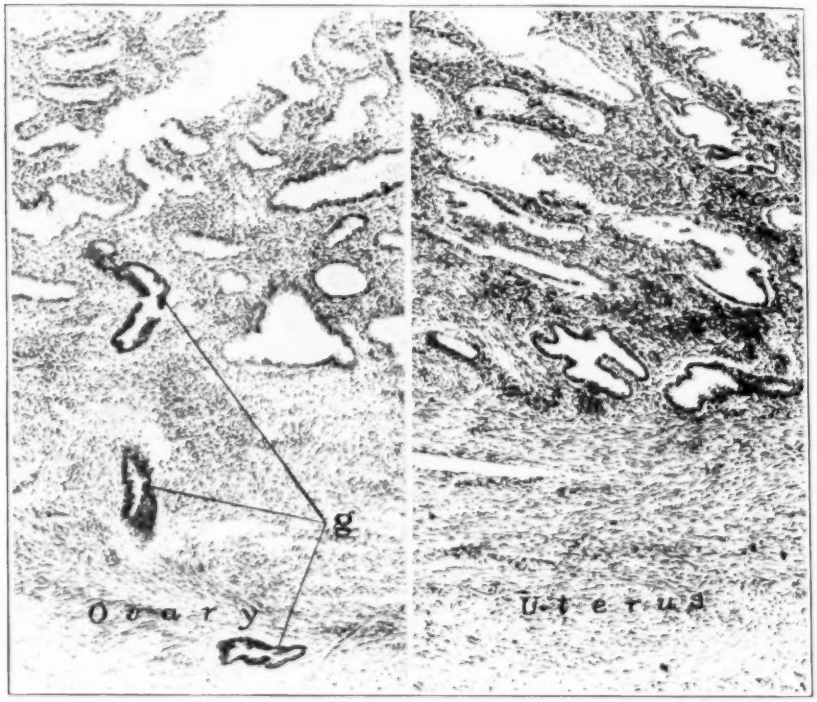

Fig. 19.—Two photomicrographs (x 60) comparing the "uterine mucosa" of the ovarian cyst with that lining the uterine cavity. The histologic structure of the two are identical. The photomicrograph (to the left) is of the portion of cyst wall indicated by the arrow in Fig. 18. From the study of other sections of this area the gland *g* could be traced through the cyst wall into the "uterine mucosa" lining its cavity. This suggests that the endometrial tissue in the ovary might have primarily arisen from similar tissue developing upon its surface. The ovarian cyst or hematoma could have arisen from the retention of menstrual blood in endometrial tissue in the ovary like that in the uterine wall (Fig. 17), just as the hematoma in the wall of the cervix shown in Fig. 21 probably arose.

Menstrual blood undoubtedly irritates the peritoneum causing inflammatory exudation, granulation tissue, adhesions and peritoneal inclusions. These would be the very conditions which would favor the retention and growth of any epithelium or other tissue present in this blood, just as similar peritoneal reactions make possible the retention and growth of fragments of cancer escaping into the peritoneal cavity. While menstrual blood may be very injurious to the mesothelium the

fragments of uterine tissue in it might remain alive for a longer time, being more accustomed to its presence.

I fully appreciate the fact that many interesting tubular structures and cavities lined by epithelium-like cells, similar to those of the uterine mucosa, may arise from the inclusion of peritoneal mesothelium by granulation tissue as a result of peritoneal irritation, but I am not convinced that these structures ever develop into typical endometrium. On the other hand, I do believe that fragments of endometrial tissue escaping into the peritoneal cavity at times become implanted on the surface of the peritoneum much in the manner of carcinoma, and as experimentally accomplished by Jacobson in lower animals. Further studies will prove the truth or fallacy of these observations and deductions. I also believe that endometrial tissue in the ovary may arise in like manner, but am not confident that it accounts for all instances of this tissue in that organ.

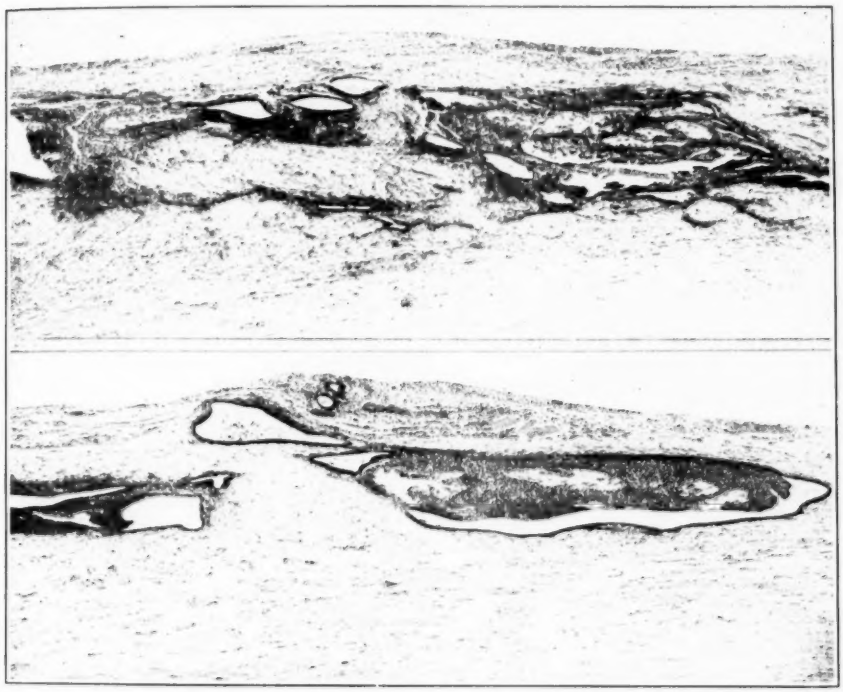

Fig. 20.—Two photomicrographs (x 25) of endometriosis of the anterior wall of the uterus from the same block of tissue as the section shown in Fig. 17 (the upper photomicrograph is from the same section as Fig. 17). The histologic structure of the endometrial tissue in this lesion is identical with that shown in Fig. 19. The method of the development of the lesion is not indicated in the upper photomicrograph. On the other hand it is suggested in the lower one. The first impression is that it might have invaded the uterine wall in an oblique direction from its peritoneal surface. I believe that this is only partly true. The larger space containing endometrial tissue is covered mainly by vascular, newly-formed connective tissue. I believe that this represents the growth of the tissues of the uterus over endometrial tissue developing upon its peritoneal surface, thus enveloping it. Should menstrual blood accumulate in these endometrial cavities, a hematoma would arise similar to the one shown in Fig. 21 and also similar to the ovarian hematoma or cyst.

Peritoneal endometriosis may occur with and without demonstrable endometrial tissue in the ovaries. If the latter is present it may be small in amount and similar to the peritoneal lesions (Figs. 7 and 8), or an endometrial cyst (Fig. 14) may be present. The peritoneal lesions may be few, small and superficial or extensive. In some instances there may be a deep invasion of underlying structures. The histology of the peritoneal changes in these lesions probably represents the reaction of the latter to two irritants, one the menstrual blood and the other the endometrial tissue. That due to the former is similar to that found in perit-

Fig. 21.—Photomicrograph (x 10) of an endometrial hematoma in the posterior wall of the supravaginal portion of the cervix (another case). This was associated with an extensive peritoneal endometriosis in the posterior culdesac involving the supravaginal portion of the cervix and the rectosigmoid, and an endometrial cyst of the right ovary. The histology of the lining of this hematoma is identical with that of the endometrial cyst of the ovary reported in this paper, normal-appearing "uterine mucosa" to the right, and the greater portion of the hematoma lined by epithelium with little or no underlying endometrial stroma, and by phagocytic pigmented cells. This hematoma or "cyst" has obviously arisen from the accumulation of menstrual blood in an endometrial cavity. The endometrial ovarian cyst described in this paper might have had a similar origin.

onitis of infectious and other origin. In addition, blood pigment is often present due to the incomplete absorption of the menstrual blood primarily causing the lesions and also from the menstrual reaction of the endometrial tissue in them. The reaction of the host toward the acquired endometrial tissue is similar to that of the tissues of the uterine wall to the endometrial tissue invading it in a direct or primary uterine endometriosis.

It is obvious that many interesting peritoneal lesions may be encountered in patients with peritoneal endometriosis, such as typical and atypical uterine mucosa on the serosa (Figs. 7 and 10), inclusions of endometrial tissue in the peritoneal reactions (Fig. 12), the invasion of underlying structures by endometrial tissue (Fig. 9) and hematomas from the rentention of menstrual blood in endometrial cavities (Fig. 21). These endometrial hematomas occur more frequently and reach a larger size in the ovaries (Fig. 14) than in other situations.

Of particular interest in connection with the case about to be reported is the presence of endometrial tissue in peritoneal adhesions especially those of the waving fringe-like type (Figs. 10 and 27). The endometrial tissue may be on the surface of or embedded in any portion of the adhesion (sometimes in the very tip) just as cancer is found in the adhesions

Fig. 22.—Photomicrograph (x 10) of the nodule of endometriosis excised from the posterior culdesac shown in Figs. 5 and 14.

of peritoneal carcinosis. Hematomas from the retention of menstrual blood might arise in the endometrial tissue of these adhesions just as they arise in the uterine wall, ovary, or any other organ or structure invaded by this tissue. The simplest form of an endometrial cavity containing menstrual blood is a dilated gland and the more complex and the more readily recognized ones are those lined wholly or in part by typical endometrial tissue (Fig. 21). It might seem that less resistance would be offered to the accumulation of blood in endometrial tissue in adhesions than in the firmer structure of the uterine wall and therefore might be the more easily distended.

INGUINAL ENDOMETRIOSIS

Inguinal endometriosis may be defined as the presence of endometrial tissue in the groin. It has also been reported as adenomyoma of the groin and adenomyoma of the round ligament.

Various theories may be considered for the explanation of the origin of the endometrial tissue in this situation and these must be modified to meet the conditions found in individual cases.

1. The congenital theory. The condition arises in developmentally misplaced portions of the müllerian or wolffian systems.

2. The metaplasia theory. It is due to a metaplasia of the mesothelial lining of the processus vaginalis peritonei or of the endothelial lining of dilated vessels.

3. A direct extension along the round ligament from a peritoneal endometriosis about the abdominal inguinal ring.

4. Metastatic through lymphatics or veins secondary to a peritoneal endometriosis invading the vessels accompanying the round ligament or from a primary uterine

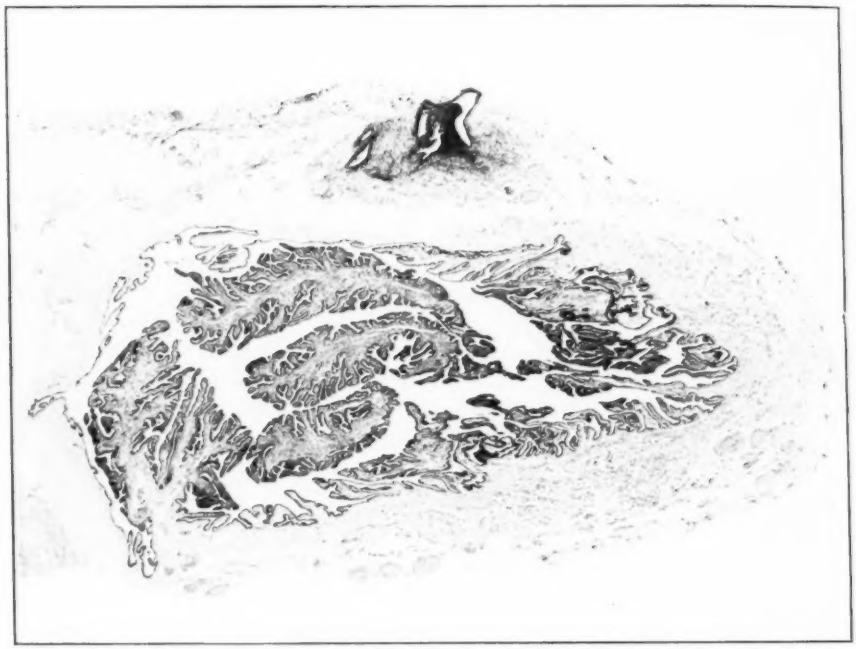

Fig. 23.—Photomicrograph (x 10) of a cross section of the right tube showing endometriosis in its lateral wall. The invasion of the tube by endometrial tissue is in large part accomplished by the "buckling in" of the tubal serosa and the local hyperplasia resulting from its reaction to the endometrial tissue.

endometriosis, or even from endometrial tissue escaping into the uterine vessels during menstruation.

5. Implantations in a hernia sac, or if we accept the metaplasia theory it is due to the reaction of the peritoneum of the sac to menstrual blood escaping into it.

In a previous communication[4] I reported three cases of inguinal endometriosis.

In the first case the endometriosis was situated just below the external abdominal ring and the round ligament was not observed during the operation. An extensive pelvic peritoneal endometriosis was present with invasion of the uterine end of the round ligament and the structures about it, on the same side as the endometrial tissue in the groin.

In the second case the mass of tissue which included the glands was adherent to the side of the terminal portion of the round ligament but I was unable to demonstrate actual invasion of that structure. A pelvic peritoneal endometriosis was also present in this case with an invasion of the tissue between the layers of the broad ligament below the uterine end of the round ligament of the same side as the lesion in the groin. I inferred that the endometrial tissue in the groin in both of these cases might have been secondary to that in the pelvis by metastasis through lymph vessels or veins accompanying the round ligament.

In the third case a femoral hernia was present and the tissue containing the endometrial elements was densely adherent to the anterior surface of the femoral vein just below the sac of the hernia. I was unable to find any endometrial tissue in the hernia sac nor did I determine the exact relation between the sac and the endometriosis. (I wish that I had had my present knowledge of the subject at that time.) The pelvic organs were inspected but not removed. Gross evidence of pelvic

Fig. 24.—Photomicrograph (x 25) of the endometrial tissue shown in Fig. 23. Its histologic structure is identical with that shown in Fig. 19. The endometrial tissue is "dipping" into the wall of the tube, and the tissues of the latter have grown over it.

peritoneal endometriosis was not observed. The uterus was slightly enlarged with what appeared to be a small leiomyoma presenting between the layers of the broad ligament of the same side as the endometrial tissue in the groin. In the discussion of the etiology of the ectopic endometrial tissue in this instance I considered the possibility of metastasis through lymph vessels or veins from a primary uterine endometriosis or from endometrial tissue escaping into uterine veins during menstruation.

The case about to be reported was briefly mentioned in a footnote of this article.[4]

REPORT OF CASE

Endometriosis of the sac of a right inguinal hernia associated with pelvic peritoneal endometriosis. Peritoneal lesions in the posterior and anterior culdesac, in the wall of the right tube, and in the hernia sac including its neck (the lumen of the

latter having been occluded or nearly so, by the endometriosis in its walls). Endometrial cyst of the left ovary.

The patient, unmarried and aged forty-four, complained of a right inguinal hernia. Menstruation was regular, moderate in amount until the last two years when it had become quite profuse. Menstrual pain had not been a marked symptom. The patient stated that she had been more conscious of the hernia during her menstrual periods the last year. (This latter information was obtained after the operation when the exact nature of the lesion of the hernial sac had been ascertained.) The menstrual flow occurred from June 10 to June 16. The hernia had been noticed for two years and had been reducible until the last four months. Pelvic examination demonstrated that the uterus was slightly enlarged and retroverted with a nodular induration in the culdesac and an adherent "cystic" mass to the left of the uterus. The preoperative diagnosis was right inguinal hernia, probably containing omental

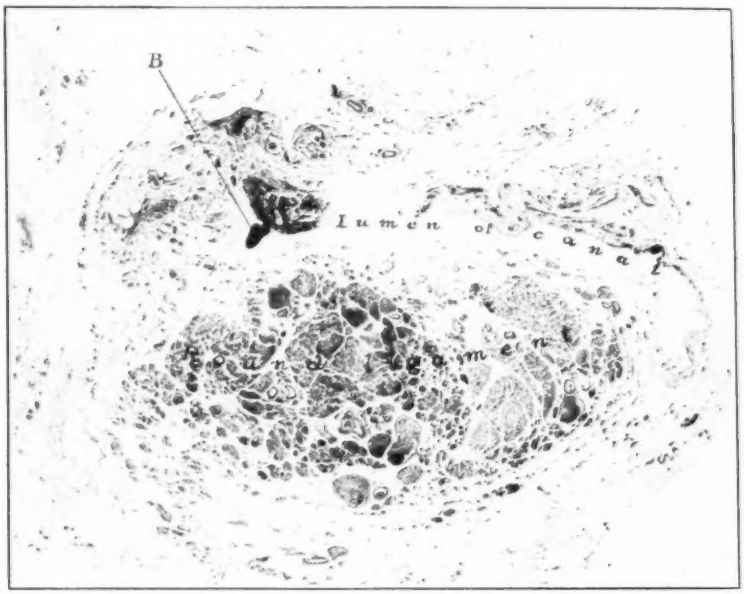

Fig. 25.—Photomicrograph (× 10) of a cross section of the neck of the hernia sac near the internal abdominal ring. The round ligament appears in cross section, and the lumen of the canal is situated just above it. A pigmented peritoneal lesion (*B*) containing "endometrial stroma" and phagocytic cells but no glands is present in the wall of the canal.

tissue, a myomatous uterus associated with endometriosis in the culdesac, and an endometrial cyst of the left ovary. The operation occurred at the Albany Hospital July 3, 1925. A median incision was first made. The uterus was found to be slightly enlarged, due to a small intramural leiomyoma in its anterior wall, retroverted and displaced to the right by an adherent cystic left ovary. Both tubes appeared patent and normal. The right ovary was of normal size and, except for pigmentation on its under surface, it appeared normal. Similar pigmented areas were also present in the dependent portions of the anterior culdesac, on the anterior surface of the uterus mesial to the round ligaments, on the anterior surface of the broad ligaments and in the vesicouterine fold of the peritoneum (Fig. 13). The peritoneum about the right internal abdominal ring was puckered and pigmented (Fig. 6). The left ovary was cystic, enlarged, and firmly adherent by its lateral and under surfaces to the posterior layer of the left broad ligament. The left ovary

was freed with difficulty and without rupturing its cyst by removing with it portions of the adherent posterior layer of the left broad ligament. On exposing the posterior culdesac (Fig. 14), an area of pigmentation was found on the posterior surface of the uterus near the attachment of the right broad ligament. There was marked induration in the culdesac just mesial to the uterine end of the right uterosacral ligament. This was also pigmented but differed in its appearance and consistency from the other pigmented areas just described. I believe that it represented an older lesion. A similar lesion was also present on the right uterosacral ligament and in the wall of the right tube near its fimbriated extremity. The appendix, left tube, ovary and uterus were removed. The pigmented portion of the right ovary was excised and also a portion of the right tube and the pigmented indurated tissue in the culdesac. The right round ligament including the peritoneum about the internal abdominal ring and the entire hernia sac were removed in one piece. The hernia

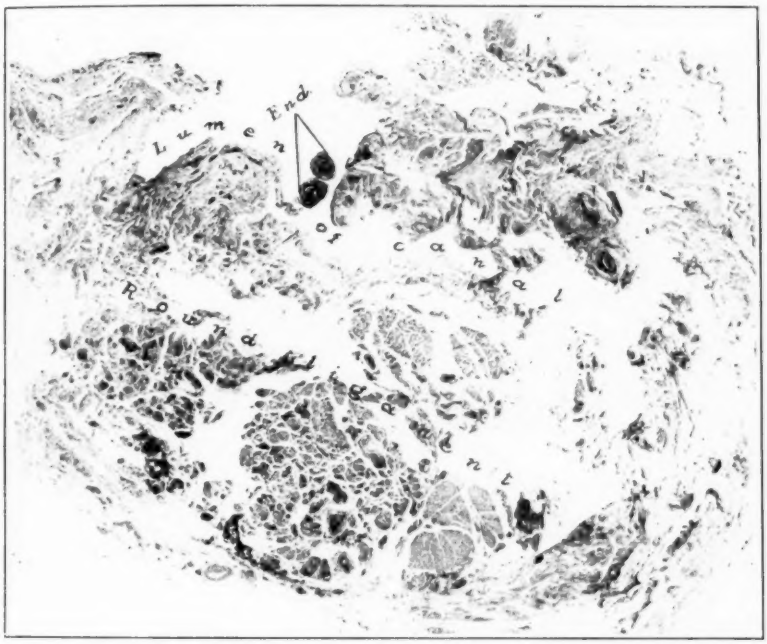

Fig. 26.—Photomicrograph (x 10) similar to the preceding one but at a lower level. The walls of the canal were torn in cutting the section. An endometrial polyp *End.* (see Fig. 27) developing in or attached to the tip of an adhesion lies in the lumen of the canal.

was repaired and the abdominal incision closed. The patient made a satisfactory convalescence.

Pathologic Findings.—The left ovary was enlarged (greatest diameter 6.5 cm.), its surface was smooth except over the area which had been attached to the posterior layer of the left broad ligament. On section it was found to have been almost entirely replaced by a hematoma with chocolate-like contents (Fig. 14). The lining of the walls of the hematoma presented the varied histologic structure so often found in endometrial cysts or hematomas, low to columnar epithelium with little or no underlying stroma similar to that of the uterine mucosa, pigmented phagocytic cells beneath the epithelium, phagocytic cells without an epithelial covering (Fig. 15) and scattered here and there areas of uterine mucosa with a structure identical with that of the endometrium of the accompanying uterus (Figs. 18 and 19). The

areas of uterine mucosa were most numerous in the portion of the cyst wall which had been attached to the broad ligament. Glands or tubules of the structure of the uterine mucosa were found on the outer surface of this portion of the cyst and these could be traced through its wall into the endometrial tissue lining it, thus suggesting that the endometrial tissue in the cyst had arisen from similar tissue developing or deposited on the surface of the ovary with its subsequent invasion of that organ and that the hematoma was created by the retention of menstrual blood in the endometrial cavity thus formed. The adhesions between the ovary and the broad ligament could have arisen either from the perforation of the cyst and the reaction to its escaped contents or from the reaction to the endometrial tissue developing on its surface.

The pigmentation on the surface of the right ovary was due to phagocytic cells in newly formed connective tissue on the surface of that organ, apparently representing an incomplete absorption of blood deposited there. Inclusions of the surface epithelium of the ovary were found in these lesions but no endometrial tissue (Fig. 16).

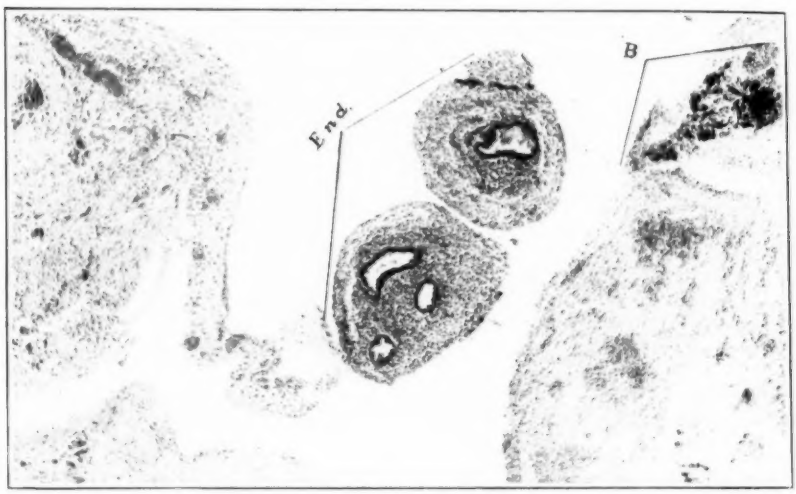

Fig. 27.—Photomicrograph (x 60) of the pedunculated endometrial polyp *End.* shown in Fig. 26. The endometrial tissue has developed in or has become attached to the tip of an adhesion, the latter forming the pedicle of the polyp. The polyp consists of typical uterine glands and stroma and strongly suggests an implantation. A pigmented peritoneal lesion is present at *B*.

The pigmented peritoneal lesions (Figs. 4 and 13) in the anterior culdesac presented a histologic picture similar to those of the right ovary except that they represented a later stage of the peritoneal reaction and typical endometrial tissue was found in some of these (Figs. 17 and 20). In one a definite endometrial cavity had developed without retention of menstrual blood. One could readily imagine that had menstrual blood accumulated in this cavity a hematoma would have resulted similar to that in the left ovary.

The endometriosis (Figs. 5, 14 and 22) in the posterior culdesac apparently represented an older lesion as shown by its being more circumscribed, less vascular, the increase in connective tissue about it and the relatively small number of phagocytic cells near its surface.

The uterine mucosa was normal and a typical intramural leiomyoma was present in the anterior wall.

The neck of the hernia sac was occluded or nearly so by the peritoneal reaction towards the endometriosis in this situation. The histologic structure of these lesions

was identical with that of the other peritoneal lesions and in addition two other very interesting conditions were present. One of these was an endometrial polyp with a long pedicle suggesting that endometrial tissue had developed or had been caught in the tip of an adhesion (Figs. 26 and 27). The endometrial tissue consisted of stroma and glands of the structure of the uterine mucosa. A polyp similar to this might have been the forerunner of the two pedunculated hematomas found in the hernia sac. The other lesion was a small mass of endometrium attached to the wall of the sac, which consisted of both stroma and glands (Fig. 28). The cellular elements of both of these stained poorly as though the tissue was necrotic or degenerating. On the other hand, healthy appearing endometrial tubules had apparently arisen from this tissue and had invaded the underlying structure. The condition strongly suggested that a fragment of uterine mucosa had become lodged in the neck of the sac and had encountered difficulty in becoming engrafted (Fig. 29).

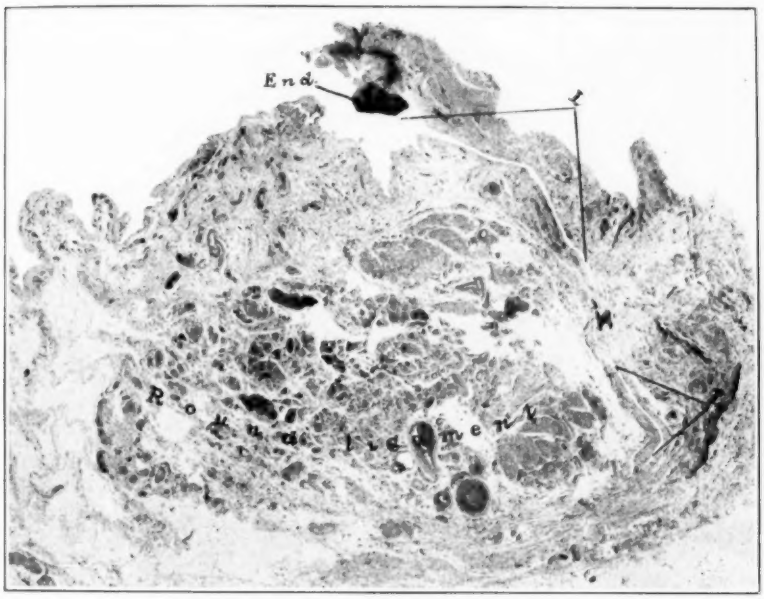

Fig. 28.—Photomicrograph (x 10) similar to Fig. 26 but at a lower level. The lumen (*L-L*) of the canal is partially obliterated by an inflammatory reaction at *X*. An endometrial lesion (*End.*) is present on and is invading the wall of the canal. See also Fig. 29.

Adhesions were present in the hernia sac. Phagocytic cells and endometrial tissue (Figs. 6, 31 and 32) were found in its wall as in the peritoneal lesions in the pelvis. The most striking lesions in the sac were two pedunculated hematomas (Fig. 6). The larger hematoma consisted of a connective tissue sac lined by flattened cells and filled with blood. There was no clue found to indicate its etiology except that it might represent a later stage of the condition found in the smaller one. The latter also had a cellular lining, in places cast off into its cavity (possibly caused by the trauma of the operation). These cells were low to cuboidal, similar to those found lining certain portions of the endometrial ovarian cyst. The underlying tissue in places resembled endometrial stroma. The contents of the hematoma consisted of blood and pigmented phagocytic cells (Fig. 33) similar to that of the ovarian hematoma. It is possible that these hematomas (especially the smaller one) might have arisen from the accumulation of menstrual blood in endometrial tissue caught or

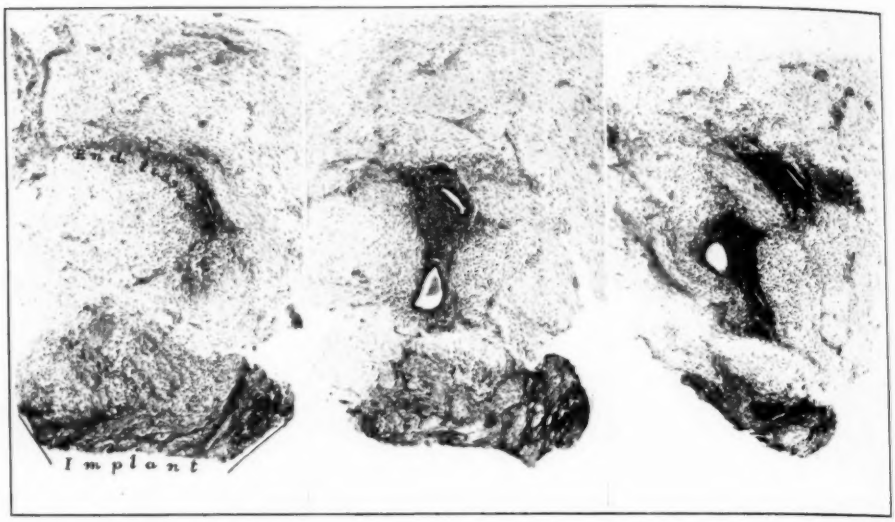

Fig. 29.—Three photomicrographs (x 60) of the endometrial tissue upon and invading the wall of the inguinal canal shown in Fig. 28. The lesion upon the surface consists of endometrial stroma and glands which stain poorly and appear to be partially necrotic. This portion suggests an endometrial implantation which had encountered difficulty in becoming established or is degenerating. Healthy-appearing endometrial tissue has invaded the wall of the canal and apparently came from a direct extension of that in the implant.

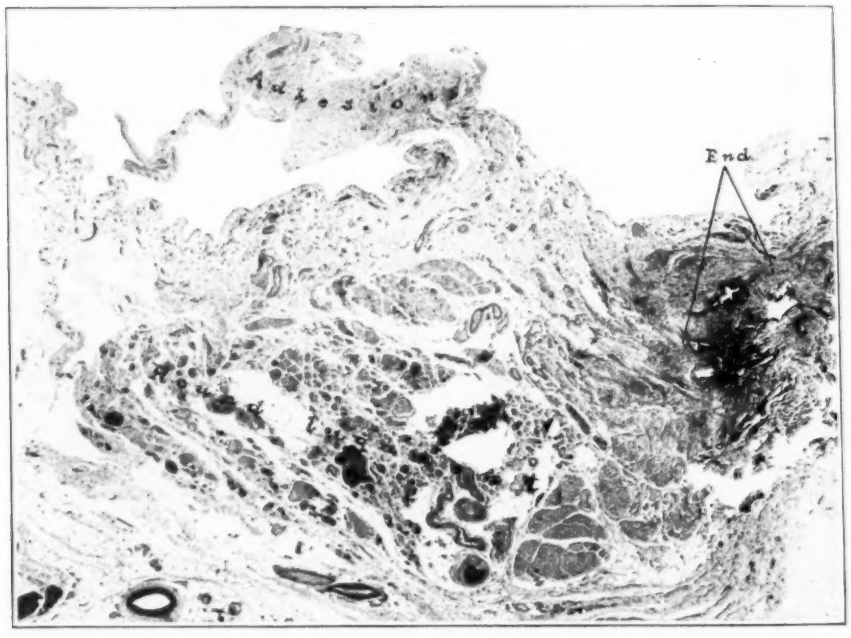

Fig. 30.—Photomicrograph (x 10) similar to Fig. 28 but at a lower level and within the hernia sac. Adhesions are present and an endometrial lesion (*End.*) is situated in the wall of the sac lateral to the round ligament.

developing in an adhesion as is occasionally encountered in peritoneal endometriosis (Figs. 10 and 11). The patient at times had worn a truss which may have traumatized and distorted these lesions.

ETIOLOGY OF THE ENDOMETRIAL LESIONS IN THIS CASE

The character and the distribution of the peritoneal lesions, found at the operation, indicated a peritoneal reaction (peritonitis) apparently due to the escape of blood or bloody fluid into the pelvic cavity (Figs. 13, 14, 16 and 17). The pigmentation of the lesions was due to the incomplete absorption of blood (Figs. 3, 4 and 5). Their histologic structure showed a peritoneal reaction with newly formed connective tissue (scars) containing phagocytic cells filled with blood pigment and also inclusions

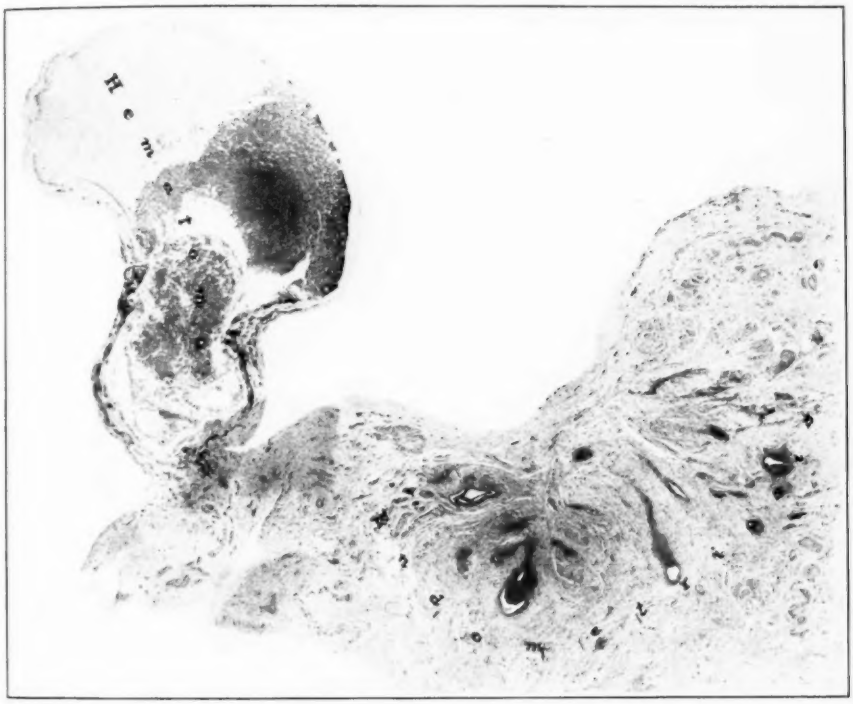

Fig. 31.—Photomicrograph (x 8) of a section through the wall of the hernia sac and the smaller pedunculated hematoma shown in Fig. 6. The hematoma is partially lined by low to cuboidal epithelium-like cells (Fig. 33) and in a few areas an underlying tissue is present resembling endometrial stroma. The contents consist of blood and phagocytic cells containing blood pigment. The epithelial lining and contents of the hematoma are identical with that of portions of the endometrial cyst of the ovary. The histology of the lesion suggests that it could be of endometrial origin similar to the hematoma shown in Figs. 2 and 10, and that the hematoma is due to the accumulation of menstrual blood in an endometrial lesion. The endometrial tissue in the wall of the hernia sac is apparently deeply imbedded in it, and there is a hyperplasia of the tissue surrounding it. For possible explanation of the development of the endometrial lesion in this situation see Fig. 32.

of the surface epithelium of the ovary (Fig. 16) and of the peritoneal mesothelium. In addition histologically typical endometrial tissue was found in some of these scars (Figs. 17 and 20), some of which (those in the posterior culdesac) were evidently older than others, indicating that there had been at least two different and distinct attacks of peritonitis arising from the escape of some material into the peritoneal cavity.

The lesions occurred in natural depressions and pockets of the pelvis (Figs. 13 and 14) and therefore their distribution would seem to be dependent more upon gravity and other physical factors than scattered areas of dormant endometrial tissue. The left ovary, containing the endometrial cyst, was fused by its under and lateral surfaces to the posterior layer of the left broad ligament (Fig. 14). It was evident that this fusion was due either to the local reaction arising from the escape of the contents of the cyst into the peritoneal cavity through a rupture or perforation of the cyst or else a peritoneal irritant from another source had been responsible, both for the endometrial tissue of the ovarian cyst and the reaction about it.

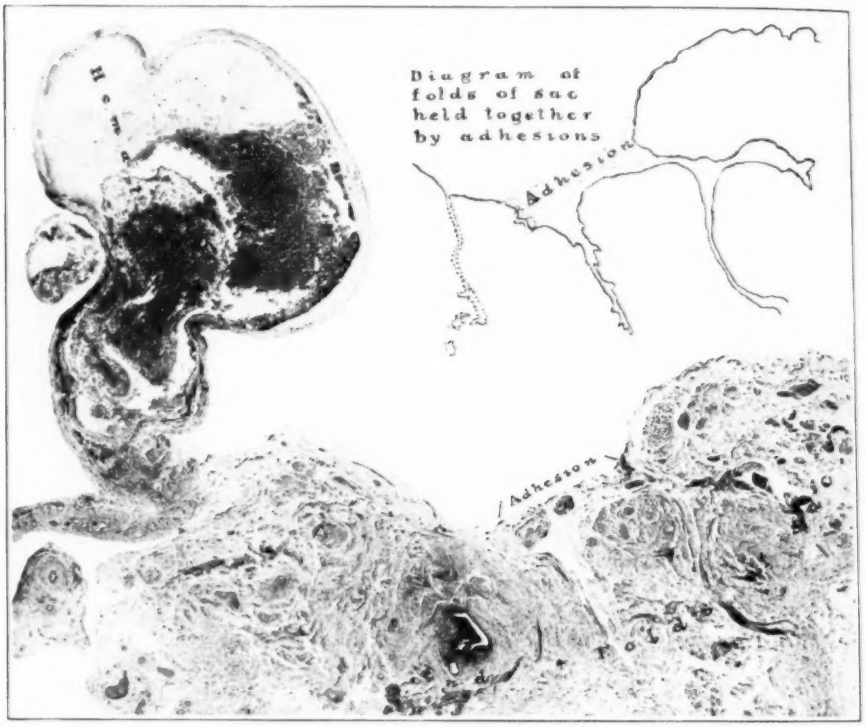

Fig. 32.—Photomicrograph (x 8) of a section from the same block as the preceding one. The right half of the wall of the sac is thrown into folds which are held together by adhesions upon the surface. These adhesions consist of vascular, newly-formed connective tissue with clumps of phagocytic cells containing blood pigment. The endometrial tissue developed in the pockets between the folds of the sac. See also Fig. 31. The subsequent fusion of the folds, together with the adhesions upon the surface, caused the endometrial lesion shown in Fig. 31. Menstrual blood escaping into the hernia sac and settling in the pockets between the folds of the sac might have caused the inflammatory reaction with resulting adhesions and fusion of the folds. The phagocytic cells containing blood pigment might represent the incomplete absorption of this blood or blood from the menstrual reaction of the endometrial tissue in the lesion. The endometrial tissue developing in the bottom of the pockets must represent either an implantation of endometrial tissue which we know is often present in menstrual blood or else the reaction of the peritoneal mesothelium to some specific ingredient of this blood. I believe the former.

Some of the peritoneal lesions could have arisen from the escape of the contents of the endometrial cyst into the peritoneal cavity but those in the anterior culdesac (Fig. 13) suggested a more recent development than those about the left ovary. Their distribution could be more readily attributed to material escaping through the left tube; both tubes were patent.

It would seem that we are warranted in assuming that the peritoneal lesions arose from the local reaction of the peritoneum to blood or bloody fluid escaping either through the tubes as a back flow of menstrual blood or from the perforation or rupture of the endometrial cyst of the ovary or from both of these sources. The

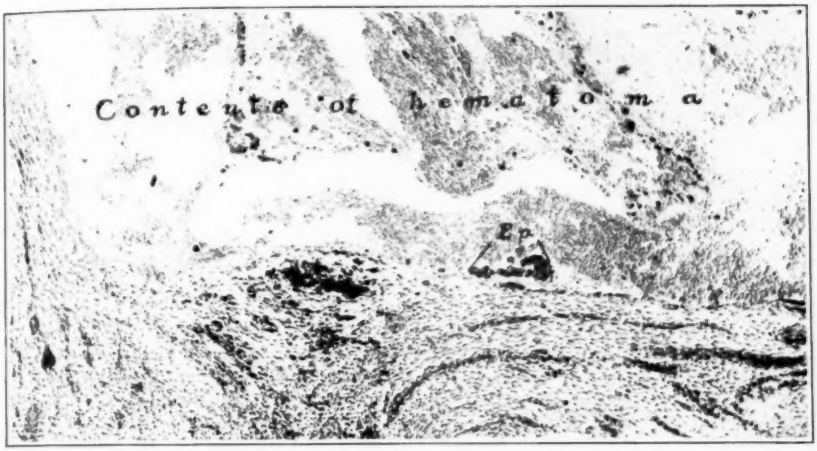

Fig. 33.—Photomicrograph (x 60) of a portion of the wall of the hematoma shown in Fig. 31. In places an epithelial lining of cuboidal cells is present. The contents consist of blood, phagocytic cells containing blood pigment, and cast-off portions of the epithelial lining. The lining of this hematoma and its contents are similar to that of portions of the endometrial cyst of the ovary, and thus suggests an endometrial origin for the former.

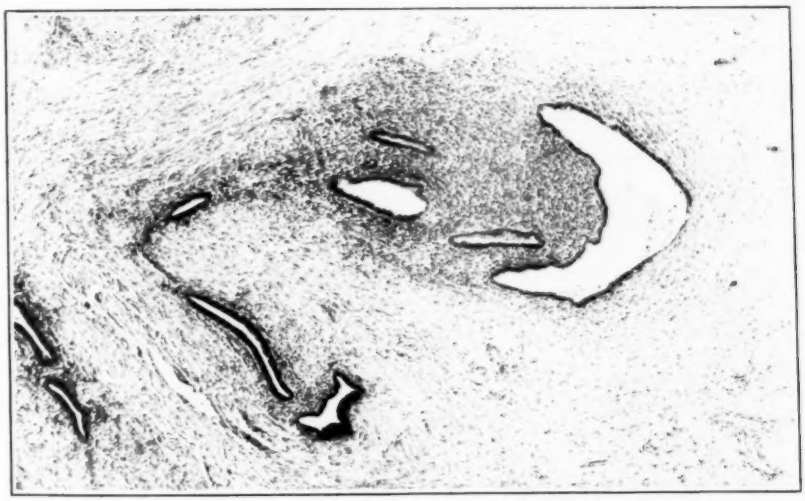

Fig. 34.—Photomicrograph (x 60) of a portion of the wall of the hernia sac containing endometrial tissue shown in Fig. 31. The histologic structure of the endometrial tissue is identical with that often found in a direct or primary endometriosis arising from the invasion of the uterine wall by its mucosa.

newly-formed connective tissue, containing phagocytic cells and mesothelial inclusions could have arisen and probably at least partly arose from this source. The endometrial tissue present in these peritoneal reactions must have been formed either from the engrafting of fragments of endometrial tissue, which we know are often

present in menstrual blood, or else in some way the peritoneum was converted into endometrial tissue by an irritant present in menstrual blood and not found in other well-known agents of peritoneal irritation.

The lesions in the hernia sac (Figs. 6 and 25 to 34 inclusive) were similar to those in the natural peritoneal depressions of the pelvic cavity and undoubtedly had a similar origin.

Glands or tubules of endometrial type were present on the outer surface of the portion of the left ovary which was fused with the posterior layer of the broad ligament. These could be traced through the wall of the cyst into the endometrial tissue lining its cavity (Figs. 18 and 19). This suggested that the endometrial tissue in the ovary came from this source and that the cyst arose from the accumulation of blood (menstrual) in an endometrial cavity developing in the ovary, just as a similar cyst or hematoma might have developed in the endometrial cavity present in the anterior wall of the uterus (Fig. 20). The endometrial tissue in the left ovary must have come either from an implantation or else from the stimulation of potential endometrial tissue in that organ.

Menstrual blood escaping into the peritoneal cavity as a back flow through the tubes might have directly or indirectly caused all of the endometrial lesions present in this case by the local irritation of the peritoneum and the implantation and growth of endometrial tissue present in this blood or from the specific influence of some ingredient of that blood on the peritoneal mesothelium and surface epithelium of the ovary. My reaction is that the endometrial tissue in the peritoneal lesions originated by implantation in the same manner as the cancer in peritoneal carcinoma may arise from the implantation of fragments of cancer escaping into the peritoneal cavity, and as experimentally proved by Jacobson in the lower animals, and that the endometrial tissue in the ovary might or might not have had a similar origin.

CONCLUSIONS

The clinical and pathologic study of pelvic peritoneal endometriosis convinces me that it is usually due to the escape of menstrual blood into the peritoneal cavity with the subsequent local reaction. Menstrual blood at times passes into the peritoneal cavity as a back flow from the uterus through the tubes, from the tubal mucosa itself, from the perforation of an endometrial hematoma of the ovary and possibly from endometrial tissue on peritoneal surfaces. Menstrual blood, like other irritants, causes granulation and scar tissue, adhesions and peritoneal inclusions. In addition endometrial tissue is often found on the surface of or imbedded in these peritoneal lesions and must arise either from the implantation of fragments of uterine mucosa which we know are often present in menstrual blood, or else in some way the peritoneum is converted into endometrial tissue by the specific stimulation of some ingredient of this blood. The experimental work of Jacobson demonstrates that similar peritoneal lesions may be produced in rabbits and monkeys by scattering bits of their uterine mucosa in the peritoneal cavity of these animals. Clinical observations indicate or at least suggest that

endometrial tissue may be successfully transplanted in human beings. The local peritoneal reaction towards the menstrual blood creates conditions favoring the retention and engrafting of any living tissue in this blood, just as similar reactions make possible the implantation of fragments of cancer escaping into the peritoneal cavity. These implantation-like lesions occur most frequently in the dependent portions of the pelvis and in its normal peritoneal pockets and folds. It is natural to assume that they might occur in a hernia sac just as tuberculosis and carcinosis have been found in the hernia sacs of patients having peritoneal tuberculosis and carcinosis. A case is reported of pelvic peritoneal endometriosis associated with an endometrial cyst of the ovary and an inguinal hernia. Peritoneal lesions containing endometrial tissue were present in both the anterior and posterior culdesac and also in the walls of the hernia sac including its neck, the lumen of the latter having been occluded (or nearly so) by the endometriosis in this situation. Observations made at the operation and the laboratory study of the specimens removed indicate that the pelvic peritoneal lesions and those of the hernia sac had a common origin and from some material escaping into these cavities and the local reaction to the same, I believe that this material was menstrual blood. The endometrial cyst of the ovary is evidence that a perforation may have occurred and the patent tubes are two avenues by which menstrual blood may have reached the peritoneal cavity and the hernia sac.

REFERENCES

[1]Stilling, H.: Versuche über Transplantation, IV, Mitteilung. Das Ergebnis der Transplantation von Uterusgewebe in die Milz, Beitr. z. path. Anat. u. z. allg. Path., 1910, xlvii, 499.

[2]Hesselberg, C., Kerwin, W., and Loeb, L.: Auto and Homotransplantation of the Uterus in the Guinea Pig, Jour. Med. Res., 1918, xxxviii, 11.

[3]Jacobson, V.: The Intraperitoneal Transplantation of Endometrial Tissue, Arch. Path. and Lab. Med., 1926, i, 169.

[4]Sampson, J. A.: Inguinal Endometriosis, Am. Jour. Obst. and Gynec., 1925, x, No. 4, p. 462.

180 Washington Avenue.

(*For discussion see page* 623.)

THE SIGNIFICANCE OF UTERINE MUCOSA IN THE FALLOPIAN TUBE, WITH A DISCUSSION OF THE ORIGIN OF ABERRANT ENDOMETRIUM*

By Emil Novak, M.D., Baltimore, Md.

(From the Gynecological Department of the Johns Hopkins University Medical School)

THE gynecologic literature of recent years contains no finer example of scientific research than is presented by the clinicohistologic studies of Sampson[1] upon the general subject of pelvic endometriosis. Though not the first to describe the occurrence of ectopic endometrium, none will dispute the fact that his studies have thrown an entirely new light upon the subject, not only by emphasizing the great frequency of the lesion, but also by offering a point of view broad enough to embrace a number of conditions hitherto described as quite separate entities, and infrequent ones at that. Gynecologists the world over have been put on the alert for this condition, and the work of the gynecologic pathologist has been given a new zest.

In common with others, we have searched our material from this standpoint, and have found endometrial tissue in many cases where its presence formerly had been overlooked. The fact that its incidence in our observation has been considerably less than that found by Sampson may be due to less searching examination of our pathologic material, to differences in interpretation, or to both these factors.

The present communication, however, does not deal with the general subject of endometriosis, but only with one of its aspects, the manner of origin of the ectopic endometrium. The menstrual regurgitation theory suggested by Sampson is a somewhat alluring one, and has attained rather general acceptance. Sampson has extended the idea of tubal transmission of tissue material to the field of cancer, and believes that ovarian cancer may be the result of the implantation into the ovaries of cancer material which has passed out from the uterus through the tubal lumen. The tubal regurgitation theory of Sampson, therefore, assumes a very pivotal importance in connection with both pelvic endometriosis and pelvic cancer, and hence it would seem worth while to bring forth all evidence tending to prove or disprove its correctness. It is only fair to say that Sampson has taken a very open-minded stand on this question, and recognizes the possibility of other etiologic factors than the one of tubal regurgitation. It is the latter,

*Read at the Fifty-first Annual Meeting of the American Gynecological Society, Stockbridge, Mass., May 22, 1926.

however, which he has particularly stressed, and which he has applied, not only to endometriosis, but also to the question of the possible extension of fundal carcinoma. It is this theory which has, therefore, been definitely associated with his name.

The demonstration of tissue in transit in the tubal lumen would seem especially important in the elucidation of this problem, and yet only a few observations of this sort, chiefly very unconvincing, have been made. With the recent great development of interest in the histology of the uterus and ovaries, which has been stimulated by our new knowledge of the cyclic physiologic changes which they exhibit, there has been very little interest in the study of the fallopian tubes. And yet, such a study offers rich rewards. For example, no one has, so far as I know, ever indisputably demonstrated a human ovum in its tubal stage, i.e., before implantation. All of the young human embryos which have been described have already been implanted in the uterus, and we are, of course, lacking in direct observations upon the preimplantation phases of development of the fertilized ovum. This important gap will be filled sooner or later, no doubt, by the discovery of the fertilized ovum in the tube.

It is surprising, in view of the countless sections of tubes which have been studied the world over, that such a discovery has not already been made, especially when one considers the comparative ease with which the ova can be recovered in some of the lower animals by washing out the generative tract.[2] In pigs, in which the occurrence of ovulation is definitely related to coitus, such studies have yielded ova at all stages of early development, as can be seen in the remarkable series of photographic studies in the Carnegie Institute of Embryology, shortly to be published by Dr. Streeter, director of the Institute.

In the human being the problem is rendered far more difficult by the uncertainty as to the exact time at which the individual woman ovulates, but there is no reason why persevering studies, made on the tubes of women operated upon at the usual time of ovulation, should not sooner or later yield a valuable material. I have recently been trying to develop a clinical technic of tubal washing, based upon that employed in some of the lower animals, but cannot report on this as yet. It would seem to be the simplest method of demonstrating the presence of loose bits of endometrial or cancer tissue.

The method of study employed for the present investigation was the much more prosaic one of studying large numbers of sections of tubes, in the hope that bits of uterine mucosa would luckily be encountered in the occasional case. Serial section study of a structure like the fallopian tube is, of course, impracticable. Without this, even the study of numerous sections from many blocks may miss any contained bits of uterine mucosa. By the study of hundreds of tubal

sections we have in a small series of cases been rewarded by being able to demonstrate endometrial particles of various sizes lying free in the lumen. Small as the number is, I believe it is larger than has been available in the entire literature heretofore. Indeed, I have been able to find only five similar cases, in addition to the one pictured by Sampson, which impresses me as rather unconvincing. In 1912, long before Sampson's work, Jägeroos[3] briefly described three cases, in all of which the migrating endometrium was evidently of the nonmenstruating type (postmenstrual or interval). Nothing is said of the condition of the ovaries, and no menstrual histories are given. In Lahm's recent case[4] the operation was done on the sixteenth day of the cycle, and in Cordua's case,[5] even more recent, there had been constant bleeding from a cervical cancer for six weeks. In the former the endometrium showed an early interval picture; in the latter it was in an early premenstrual phase. Both authors discuss the possibility of the endometrium having been squeezed into the tubes by the operative manipulation, and both express the view that such an occurrence is not sufficiently common to lend support to Sampson's theory.

More important than the mere demonstration of this tissue in the tubal lumen, however, is the application of these findings to Sampson's theory of menstrual regurgitation. Some of my cases are of exceeding interest in this respect, while the others possess much less significance, chiefly because of the fact that all or a part of the ovarian tissue was conserved to the patient, and hence was not available for study. Even when the ovary is available, it is easy to miss endometrial tissue unless blocks are cut from the fresh, unfixed tissue, for fixation obliterates the distinctive appearance of the endometrium unless present in large amount, as with definite chocolate cyst formation. It is well worth while, in all suspected tissue, to cut numerous blocks when the tissue is still fresh. Endometrial tissue will be found much more elusive when one searches for it in ovaries which have been fixed, as I have found to my regret in this study. No other problem in gynecology illustrates more forcibly the importance to the surgeon of being his own pathologist.

CASES SHOWING ENDOMETRIAL TISSUE LYING FREE IN THE TUBAL LUMEN

CASE 1.—The patient, A. M., was forty-eight years old and complained chiefly of painful menstruation and painful defecation. These symptoms had been present for two years. Menstruation had begun at twelve years. It occurred at regular four-week intervals and lasted 7 days (formerly 5 days). There was severe colicky pain on the first two days. The last period had begun on June 14. For two years there had been severe pain on defecation, especially on the first few days of menstruation.

Examination showed the uterus to be of normal size and in normal position. Behind the cervix there was a small cluster of nodules, the largest about the size of a pea. Both tubes and ovaries appeared to be adherent and tender, though not much enlarged.

Operation, on July 11, consisted in supravaginal hysterectomy, double salpingo-oophorectomy, and appendectomy. The uterus was slightly above the average size and adherent posteriorly to the rectum. The tubes were patent and, together with the ovaries, matted to the posterior surface of the uterus and broad ligaments. On separating these adhesions each ovary was seen to contain a chocolate cyst about 3 cm. in diameter. A number of small nodules, containing chocolate colored blood, were found in the uterosacral ligaments. The rectum was adherent to the back of the cervix.

Fig. 1 shows a section of the outer third of the right tube. Within the lumen one rather large and several smaller particles of perfectly definite uterine mucosa are seen. The uterus shows a typical premenstrual endometrium (Fig. 2). The ovaries both show considerable endometrial tissue, the most interesting feature, from the present standpoint, is the presence on the free surface of premenstrual

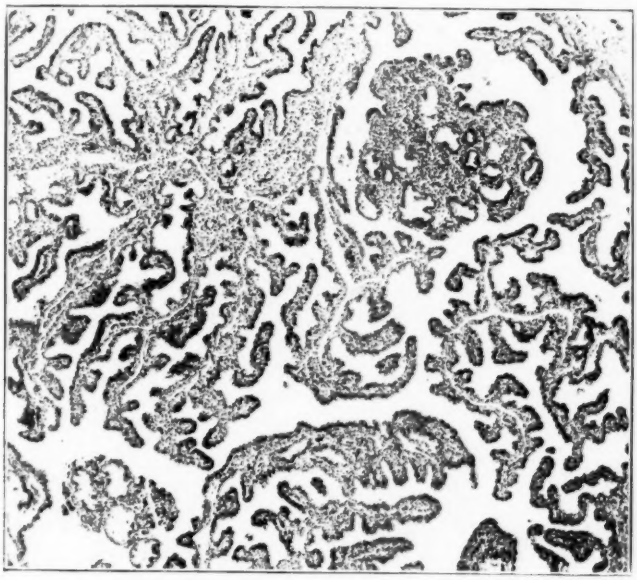

Fig. 1.—A section of the outer third of the tube, showing several particles, one quite large, of well-preserved premenstrual endometrium (not menstrual or degenerated). The woman was not menstruating, and the uterine endometrium shows a characteristic premenstrual hypertrophy (see Fig. 2). The patient expected to menstruate in a day or two. The larger bit of mucosa in the tube (upper right quadrant) could hardly have entered the inner orifice of the tube (see Fig. 4). The logical source of the migrating mucosa is the endometrium on the free surface of the ovary (see Fig. 3). The same magnification was used for Figs. 1, 2, 3, and 4.

endometrium just like that in the uterus, but also like that which lies free in the lumen (Fig. 3). The illustration, moreover, shows the polypoid projection of premenstrual endometrium to be directly continuous with mucosa exactly resembling that which is normally found lining the tube. It is apparently the fimbria ovarica.

Comment.—At first thought one might interpret the findings in this case as confirmatory of Sampson's theory of tubal regurgitation of uterine mucosa. There are a number of serious objections to such an interpretation.

In the first place, the woman was not menstruating, a fact which was checked up before as well as after the operation. Secondly, the

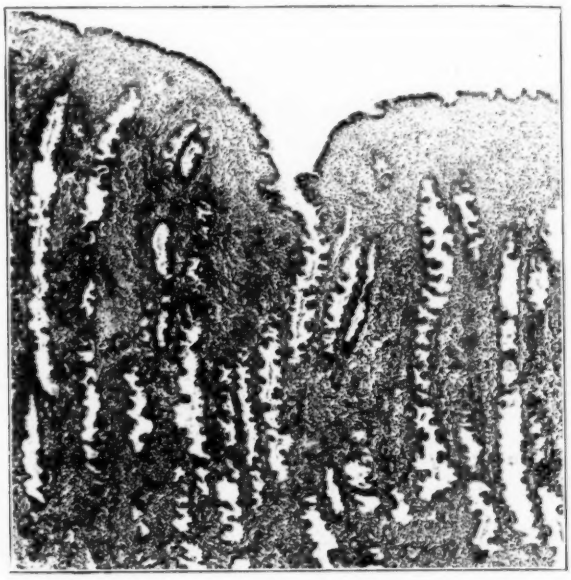

Fig. 2.—Intact endometrium, with premenstrual hypertrophy, of patient in whose tube free mucosa was found (see Fig. 1). The ovary of the same side showed premenstrual endometrium also (Fig. 3).

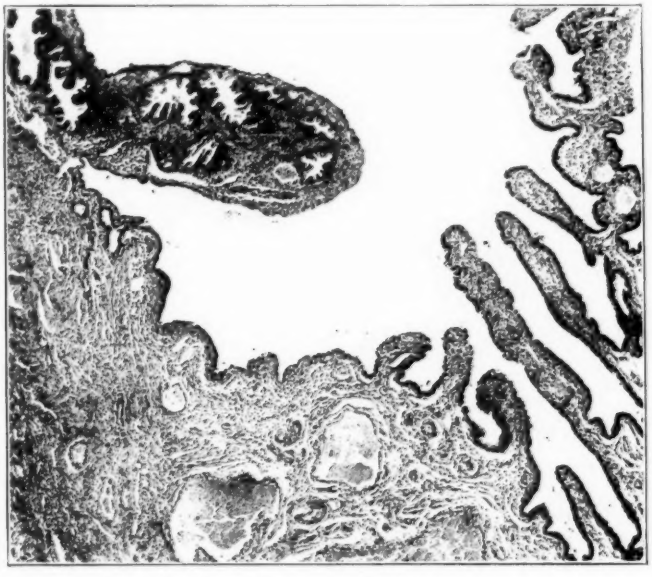

Fig. 3.—Polypoid mass of premenstrual endometrium on surface of ovary, near hilum, in close contact with the open mouth of the tube. There was a great deal of endometrium in other parts of the ovary also, and this offers a logical explanation for the free particles, which have probably broken off from the ovary and are migrating down the tube toward the uterus (see Fig. 1). This is certainly far more likely than to assume that the free particles broke off from the uterine surface, entered the tiny uterine opening of the tube, traveled up-stream, and, after several days, were still able to grow on the ovary.

mucosa of the uterus is not of the menstruating type, but is typically premenstrual, with no signs of degeneration and with an intact surface covering. Thirdly, the tissue which lies free in the lumen of the tube is likewise of the premenstrual type, and is well preserved. Fourthly, the migrating bits of uterine mucosa are so large that it is almost incredible that they could have made their way into the uterine end of the tube. A section of the cornual portion of the tube is shown in Fig. 4, and is seen to be narrower than the larger portion of endometrium in the tubal lumen. Fifthly, the endometrium on the surface of the ovary offers a far more logical explanation of the uterine tissue in the tube. It is easy to see how particles of the

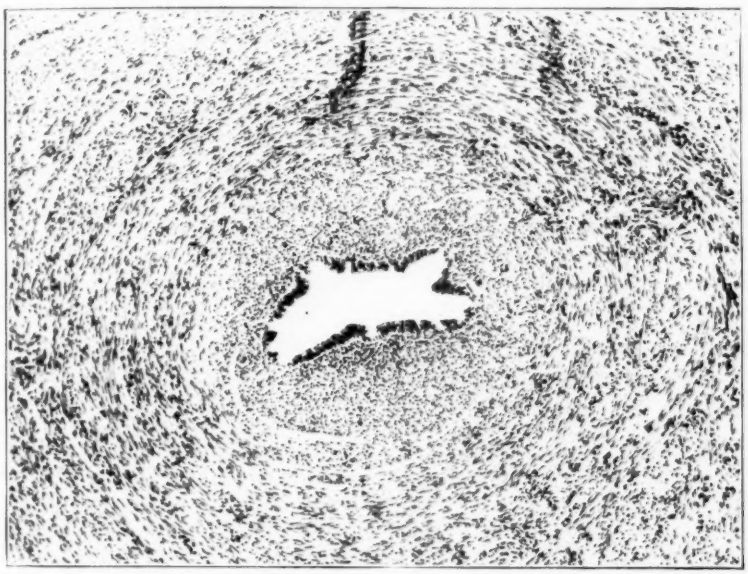

Fig. 4.—Section of interstitial portion of the same tube shown in Fig. 1, which contains free uterine mucosa. The lumen, which is of about the usual size for the normal tube in this region, seems too small to give passage to such a large particle of mucosa as is seen in Fig. 1, or in Figs. 7, 8, 9, or 10. All these photomicrographs are with the same magnification.

ovarian endometrium can break off, readily entering the wide open funnel of the tube and passing down its lumen, just as the ovum does. In other words, I believe that the evidence in this case points to the ovary as the origin of the migrating endometrium, which, therefore, is passing towards and not from the uterine cavity.

The same explanation can be made of the single example pictured by Sampson of free endometrium in the tube. It is possible that the colored photomicrograph may not do his section justice, for it would seem to leave doubt as to the endometrial nature of the tissue in the lumen of the tube. Aside from this, however, free endometrium in such a case, according to my observations, would be much more

likely to have its source in the ovary. This interpretation of Sampson's case is strengthened by the picture which he presents of a large endometrial area near the surface of the ovary of the same case. This, to my mind, is the logical source of the endometrial tissue in the lumen of the tube.

There is no reason, of course, why endometrial tissue should not sooner or later be found in the lumen of tubes removed during actual menstruation. Even if it were, I believe that the evidence presented in this paper would indicate that it had its origin in the ovary rather than in the uterus.

CASE 2.—M. R., white, aged forty-eight years, was admitted on July 31, 1925, with a history of irrregularity of menstruation for 8 years. The periods began at fifteen years, and had previously occurred at 4-week intervals, with a moderate flow lasting one week. About 8 years ago the menses became irregular, with periods of amenorrhea often lasting 3 months. They were at times quite free and prolonged (6 days to 2 weeks). On Dec. 1, 1924, there was a free flow lasting 2 weeks, then amenorrhea to March 1, at which time a normal period occurred. Following this there was amenorrhea to June 1, when a free flow of 5 days occurred. Since then there has been some irregular bleeding, with slight dull pain in the lower abdomen. The patient had been married 30 years and had had 12 full-term pregnancies.

Examination showed marked relaxation of the outlet, with cystocele and rectocele. The cervix was three times the normal size, with a deep laceration, but no suggestion of malignancy. The fundus was likewise enlarged to two or three times normal size, but no adnexal abnormalities were palpated.

Operation, on August 1, 1925, showed the uterus to be three times the normal size as the result of the presence of adenomyoma. Because of the patient's age, the long history of bleeding, and the condition of the cervix, panhysterectomy was done, together with double salpingo-oophorectomy. The tubes were open at the time of operation and the ovaries were described as relatively normal. The section shown in Fig. 5 is taken from the right tube and contains definite endometrial stroma in its lumen, but without glands. There is also a definite but small amount of endometrium in the hilum of the right ovary (Fig. 6). The uterus shows an adenomyoma and the surface endometrium exhibits a typical interval pattern, with a tendency to mild hyperplasia in some areas, and is, of course, totally different from that of a menstruating endometrium.

Here again we have endometrium in a tube which is open to communication with an ovary also containing endometrium. The operation was done at a time apparently removed from menstruation, the endometrium being of the characteristic interval type.

CASE 3.—L. W., colored, aged twenty-five years, was admitted on June 15, 1925. Her chief complaint was pain in the lower abdomen, chiefly left-sided, since September of 1924. There was also considerable dysmenorrhea and some leucorrhea. The menses had appeared at fourteen, with 28 day intervals and moderate flow lasting 4 days. The date of the last period was June 1, 1925, the one preceding, May 3, 1925. She had been married 12 months and had had 3 miscarriages in the past few years.

Examination showed marital outlet, with no relaxation. Cervix high in vault, pointing downward and backward. The uterus was normal in size and position. The left tube and ovary were definitely adherent though only slightly enlarged. The right adnexa could not be felt.

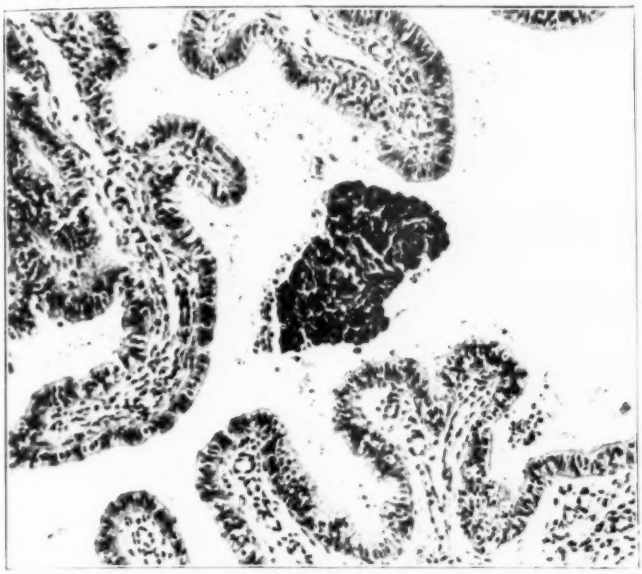

Fig. 5.—Section of tube containing an island of what is evidently uterine stroma, though no glands are seen. The patient had had slight irregular bleeding for two months, but the uterus shows a characteristic interval endometrium. The likely source of the endometrium in the lumen would seem to be the ovary of the same side, for it contains endometrial tissue (see Fig. 6).

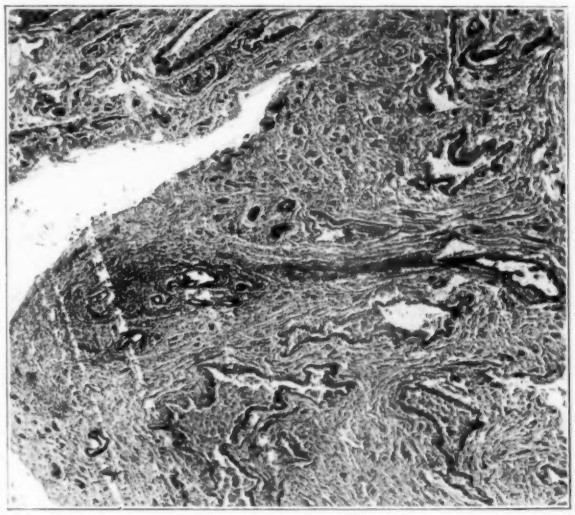

Fig. 6.—Ovary of same case as tube shown in Fig. 5. It shows definite endometrium. It is probable that more abundant areas could be found if extensive search were made for them.

At *operation*, on June 16, 1925, the otherwise normal uterus was found tightly adherent to both rectum and bladder. Both tubes were open but both showed considerable enlargement and thickening, with firm surrounding adhesions. The operation consisted in left salpingo-oophorectomy, right salpingectomy, modified Coffey hysteropexy and appendectomy.

The section illustrated in Fig. 7 shows definite endometrial tissue in the right tube. Its structure suggests that it might have been thrown off from the ovary several days earlier, as it is typically postmenstrual. There were a few small tubules on the surface of the left ovary. It was doubtful whether these could be considered real endometrium. This patient was not menstruating at the time of the operation, which was done on about the fifteenth day of the cycle. The ovary on the side of the tube which contained endometrium was not available for study.

CASE 4.—D. S., white, aged forty-eight years, entered the hospital on September 24, 1924, with a history of uterine bleeding for 3 months. Menstruation began at 13, was always irregular, with intervals varying from 21 to 25 days. The duration was 7 or 8 days; the amount was rather large, and there was slight dysmenorrhea. For one year there had been marked irregularity, with frequent attacks of

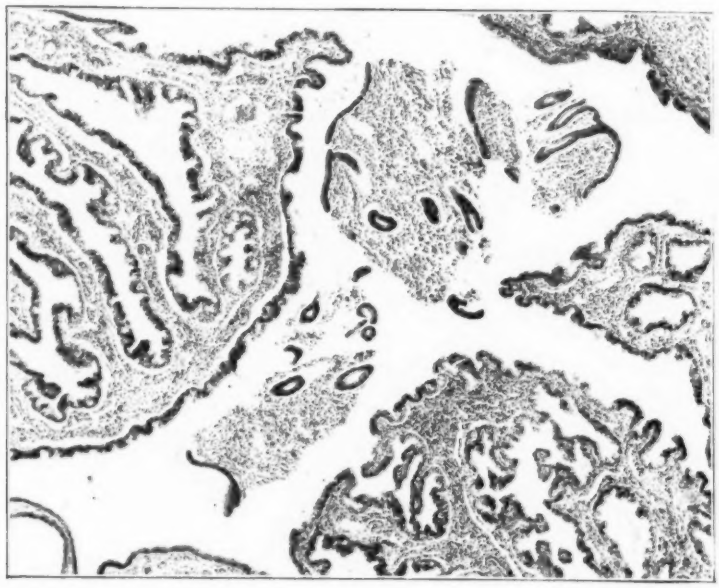

Fig. 7.—Tube removed on fourteenth day of menstrual cycle, with several large particles of uterine mucosa in the lumen. Neither the uterus nor the ovary on the side of this tube was removed. Certainly, however, neither the menstrual history nor the appearance of this tissue would justify any association with menstruation. The typical postmenstrual character of the endometrium suggests that it had been thrown off several days earlier.

moderate bleeding, lasting usually 7 to 9 days, with periods of about 10 days between these of only slight show of blood. The last menstrual period occurred on September 17, 1924. There was no bleeding at the time of admission to the hospital. The patient had been married 22 years. There was one child, twenty-one years old. The delivery had been instrumental and had been followed by a pelvic abscess, necessitating pelvic puncture.

Examination showed a retroverted, adherent uterus and marked tenderness, without much enlargement, in both adnexal regions.

At *operation*, performed September 25, the uterus was found to be held to the rectum and sigmoid by fine avascular adhesions. Both tubes were slightly thickened and adherent to the ovaries, although the fimbriated ends were open. Aside from the light adhesions, the ovaries were normal. Both tubes were removed, but the

uterus and ovaries were conserved, except for a small bit of one ovary, which was excised in order to facilitate removal of one of the adherent tubes.

The pathologic examination showed a mild chronic salpingitis. In one of the tubes there was found a large particle of unquestioned endometrial tissue (Fig. 8). It showed a postmenstrual pattern and was well preserved. The operation in this patient was done on the eighth day of the menstrual cycle, shortly after the cessation of a menstrual period. (See menstrual history.) The material available for study does not, of course, clear up the question of the endometrial tissue in the tubal lumen. The history, however, demonstrates quite clearly that it cannot be related to menstruation, which occurred 8 days before. Aside from this, the tissue is too well preserved to be interpreted as tissue cast off at menstruation, while the histologic pattern is definitely that of the postmenstrual and not the menstruating phase.

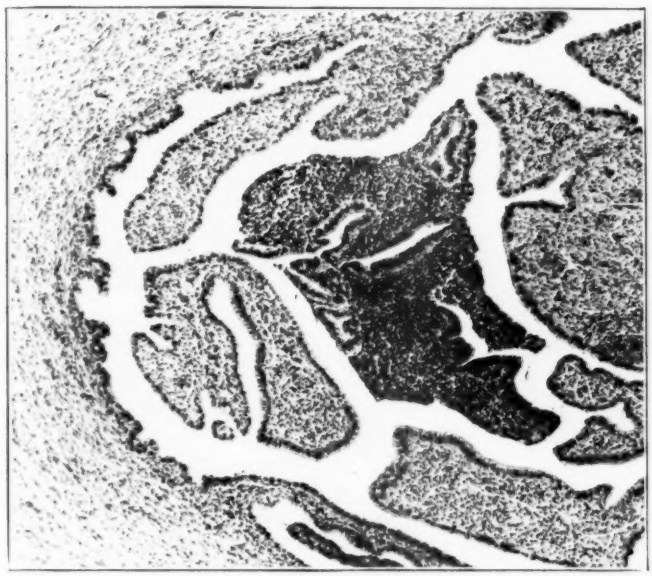

Fig. 8.—Section of the tube showing a large particle of uterine mucosa. Operation was done on the eighth day of the cycle, and the endometrium in the tube shows the usual postmenstrual picture. The uterus and both ovaries were conserved. The latter were described as adherent, and may very possibly have contained the endometrium, which would explain the free bits in the tube. An origin from the uterus seems difficult to imagine, if one compares the size of the particle with the usual size of the interstitial tube, as shown in Fig. 4.

Case 5.—L. R., white, aged thirty-eight years, was admitted on February 1, 1925, with the complaint of pain in the left lower abdomen, since an appendectomy eighteen years previously. Menses had begun at eleven years, the intervals were 28 to 30 days, the duration was 4 to 6 days, the amount was free, and there was severe dysmenorrhea. The date of the last period was Jan. 23, 1925. The patient had been married twice (total period 23 years). There had been in all two children and one miscarriage.

Examination showed, in brief, a moderately relaxed outlet; laceration of cervix; fundus normal in size and position; adherent and tender adnexa.

Operation was done on February 2, 1925. There were no intestinal adhesions to the old scar. The uterus and right adnexa were comparatively normal, except for adhesions of the small intestine and the omentum to the ovary. The left tube and

ovary were adherent, although the fimbriated end of the tube was patent, as was that of the right tube. Left salpingo-oophorectomy was done, with a modified Coffey suspension.

The tube in this case was found to show a large particle of uterine mucosa in the postmenstrual phase (see Fig. 9). The woman was not menstruating, the operation being done on the tenth day of the cycle. The ovary showed extensive interstitial hemorrhage, and in some sections small, gland-like spaces were seen just below the surface. It is probable that this ovary contains endometrial tissue, although I have not yet been able to demonstrate it in an unquestioned way in the fixed specimen.

CASE 6.—M. F., colored, aged twenty-eight years, was admitted on September 10, 1925, complaining chiefly of uterine bleeding. Menstruation had begun at twelve years, and was formerly regular at 28-day intervals, the duration being 3 or 4 days, the amount rather free, with slight pain. In 1919 the patient began to have

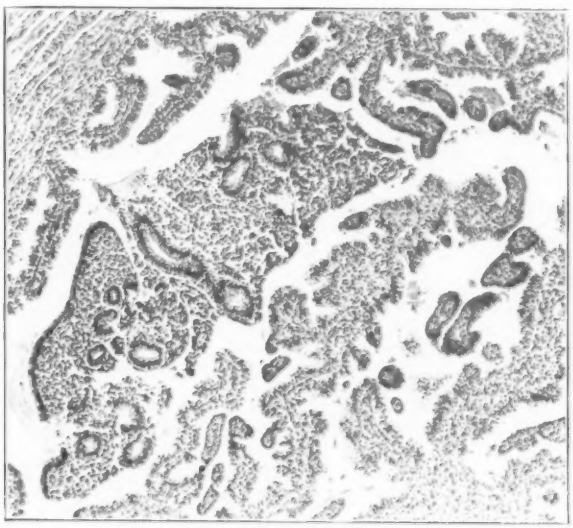

Fig. 9.—Large fragment of uterine mucosa lying free in the lumen of a tube removed on the tenth day of the cycle. It shows a postmenstrual picture, suggesting that it might have been thrown off from the ovary two or three days earlier. It could hardly be explained in any other way, in view of its large size, its histologic structure, its good preservation and the fact that the patient was not menstruating. The ovary showed extensive "interstitial hemorrhage" and almost surely contained endometrium, although it was not demonstrated, as the gross specimen was no longer available at the time of this study.

occasional amenorrhea of 2 or 3 months, often followed by menorrhagia, although there was no evidence of abortion as a cause of this. Dysmenorrhea and leucorrhea were also present. There was a regular menstrual period about August 15, 1925. Bleeding began again on September 1 and was still present when the patient was admitted. The patient had been married 6 years and there had been 3 pregnancies, one terminating in stillbirth at term, the other two in early miscarriages.

Examination showed outlet without much relaxation; a slight bloody vaginal discharge; the cervix large and hypertrophic; the fundus normal in size and position; the tubes tender, adherent, and somewhat enlarged.

Operation on September 12, 1925, showed both tubes the seat of definite inflammatory disease, with marked adhesions and considerable angulation. The fimbriae were open. Both ovaries were apparently normal, except for surrounding adhesions.

The uterus was adherent to the rectum posteriorly. Panhysterectomy, with double salpingectomy, was done. Only a small cystic bit of the left ovary was removed.

The most interesting find on microscopic examination is seen in Fig. 10, which shows several large bits of uterine mucosa caught in transit. It is of the postmenstrual type, while that of the uterus is of the early interval type. Unfortunately, no ovarian tissue is available for examination, but I believe it would have shown endometrial areas. Such large particles as are here shown could scarcely have made their entrance into the uterine end of any tube, but they could quite readily have dropped into the wide open fimbriated end. Certainly neither their own appearance nor that of the uterine endometrium can associate them in any way with menstruation.

CASE 7.—D. H., colored, aged eighteen years, was admitted on August 16, 1925. There had been dull, aching pain in the left lower abdomen since August 3. A

Fig. 10.—Tube removed on the ninth day of the cycle, showing a large particle of postmenstrual endometrium, with only a few glands. The uterus showed a typical interval endometrium, so that there is much reason to believe that the migrating endometrium, which is of the postmenstrual type, was cast off from the ovary several days before the operation. It would hardly have gotten into the tube from the uterine side, and the uterine mucosa shows a more advanced development than the tubal particle. The ovaries were both conserved. They were described as "normal except for surrounding adhesions," and the uterus was adherent to the rectum. I believe that endometrium would have been found in the ovaries had they been removed.

slight amount of dark reddish discharge had been present during this time (one or two napkins a day). There was some burning on urination and some vesical and rectal tenesmus. Menstruation had begun at thirteen years, with 4-week intervals, rather free, lasting 7 days; there had been dysmenorrhea for 3 or 4 years. The patient had been married 2 years but had had no pregnancies.

Examination showed a nulliparous outlet, with no bleeding at time of examination. The cervix was quite high in the vaginal vault. The uterus was of normal size and pushed to the left by a small, adherent mass in the right side of the pelvis.

Operation, on August 20, showed many old and firm omental adhesions. There was about 150 c.c. of light, straw-colored fluid in the pelvis, but no blood. Both

tubes were apparently closed at their fimbriated extremities, which, however, were not completely inverted. They were only moderately enlarged and thickened, but there were definite nodes at each isthmus. The right ovary was the seat of a definite abscess about 4 cm. in diameter and matted in adhesions. The left was comparatively normal except for adhesions.

The illustration (Fig. 11) is from the right tube. Definite tuberculosis was found in both tubes and also in the right ovary. The left ovary was not removed. The particle of tissue in the lumen certainly looks like a uterine gland and stroma. How did it get into the tube? Scarcely through the uterine end, for this was the seat of a typical tuberculous salpingitis isthmica nodosa, which blocked the lumen completely. Tuberculous tubes are notoriously prone to remain partially patent at the fimbriated ends. This channel of communication would seem to be the likelier

Fig. 11.—Part of the wall of tuberculous tube, showing small bit of what seems to be definite endometrial tissue lying free in the lumen. The menstrual history of this patient, who was colored, was rather indefinite, but she is said to have had a slight reddish discharge for two weeks before operation. The glands in the endometrial particle suggest a beginning premenstrual change. The point of chief interest is the fact that the tube was blocked at its uterine end by a tuberculous salpingitis isthmica nodosa, while the fimbriae, as is so common with tuberculous tubes, were described as partially everted, so that the tubal orifice was almost surely not completely blocked. This makes the ovarian origin of the endometrium very probable, though it cannot be proved, as the ovary on the side of the tube was not removed. The other ovary and tube showed tuberculosis. The uterus was conserved.

one in this case, as the fimbriae were partly everted in the tube in which the endometrium was found.

CASE 8.—E. McN., colored, aged thirty-eight years, was admitted to the hospital on December 18, 1916, with a history of sharp, colicky pain in the lower abdomen for the three weeks preceding. She had been married 23 years and had two children, twenty-one and nineteen years of age. Menstruation had begun at eleven years, was regular every 4 weeks, lasting 3 and 4 days, with some dysmenorrhea. For 1 year there had been some irregularity, the periods often appearing twice a

month. The last period began on November 20, 1916. Following this there was a whitish discharge with some bloody admixture.

Examination showed a uterus which was definitely enlarged, while in the culdesac there was felt a tender, indurated mass.

Operation, on December 21, 1916, showed the right tube to be the seat of an unruptured pregnancy. Its inner half was comparatively normal in appearance, while the outer portion was about 4 cm. in diameter. The left tube was adherent and its fimbriated end was sealed off. The operation consisted of right salpingo-oophorectomy and left salpingectomy. The right tube, when opened through the distended area, showed a collection of blood in which there was a chorionic sac containing a fairly well preserved embryo of about nine weeks' development, according to the estimate of Dr. Mall, then Director of the Carnegie Institute of Embryology.

Microscopically, the usual picture of tubal pregnancy was found in the right tube. In one of the sections taken between the embryonic area and the uterus

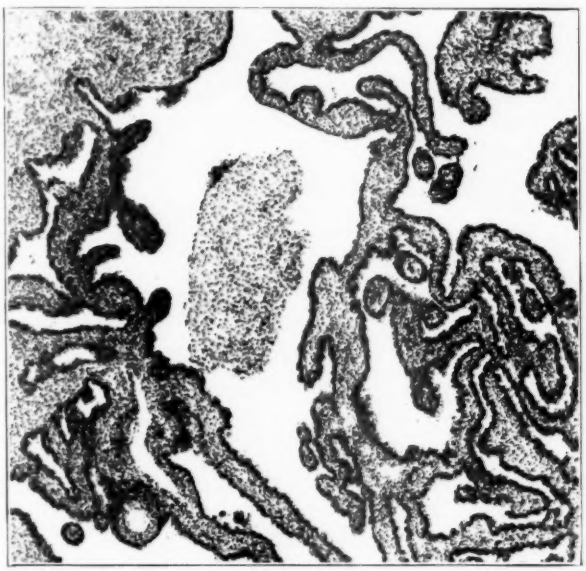

Fig. 12.—Section of tube showing follicular salpingitis. In the lumen is seen a clump of cells resembling the trophoblastic nodules (by some considered decidual) found so commonly in sections of pregnant tubes. There was a pregnancy in the outer portion of this tube, and sections through the implantation area show islands like that shown in the illustration. This was made from a section between the pregnancy and the uterus, indicating that the particle was migrating down the tube toward the uterus.

there was seen, lying free in the lumen, the island of cells shown in Fig. 12. They are exactly similar to many cell islands seen in sections through the pregnancy, and which represent the so-called trophoblastic nodules. While this case has no immediate bearing upon the question of possible endometrial transportation through the tubes, it is suggestive as another example of transportation of tissue in a downward direction, towards the uterus.

DOES MENSTRUAL BLOOD REGURGITATE THROUGH THE TUBE INTO THE PELVIS?

In the past few years we have, whenever the opportunity presented itself, operated upon women who happened to be menstruating, and

we have always carefully examined for evidence of the escape of blood from the tubes, when these were patent, as they were in at last 13 of the menstruating women upon whom operation was done. In not a single case was it possible to demonstrate the escape of blood from the tube, or the presence of free blood in the pelvic cavity. In only one case, in my own experience, so far as I recall, could I feel that blood had passed back from the uterus into the pelvis, and that single case was not related to normal menstruation. It was a case of very profuse climacteric hemorrhage of many days' duration, in which a physician had inserted an extremely firm tampon to control the bleeding before sending the patient into the hospital. At the operation, which was a hysterectomy, a small amount of free blood was found in the pelvis, presumably having been forced back from the uterus.

A favorite time for pelvic operations is immediately after the cessation of the menstrual period. This time appears to be popular with both patients and surgeons. For instance, many patients who begin to menstruate after admission to a hospital are held over and operated upon immediately after the cessation of the period. If menstrual regurgitation through the tubes were common, would we not, in the innumerable operations done just after the period, often find traces of blood in the pelvis? If our observations in cases of tubal pregnancy can be taken as a guide, this question must be answered affirmatively. It is hard to believe that free blood would disappear so quickly, or that so many thousands of surgeons could have been so unobservant as to fail to notice it if it were present at this time.

Again, histologic examination of tubes removed during menstruation usually shows them to be free of any bloody content. Occasionally, a small amount of blood is seen, but not any more commonly than is the case with tubes removed at other parts of the cycle (Fig. 13). Even if, in the occasional case, blood were demonstrated escaping from the tubal end, it would be difficult to exclude the existence of pathologic conditions in the tube (mild salpingitis, etc.). Some of the few reported cases of menstrual regurgitation are obviously inaccurate. For example, the case reported by Schmid[6] was almost certainly one of bleeding from a tubal abortion. He states that the patient had amenorrhea for two months, followed by bleeding for five days. The tube was distended in several places and there was slight bleeding from the fimbriated end. The tube was not removed, so that no histologic study was made.

Furthermore, it is difficult to understand why the escape of menstrual blood into the abdominal cavity would not often cause symptoms of peritoneal irritation similar to those seen with hemorrhage from the tube in tubal abortion. If our ideas of the latter are correct, each escape of blood, however slight, produces pain, often nausea and

vomiting, and sometimes shock. The peritoneal reaction is likewise reflected in the leucocyte curve, according to the observations of Farrar. There is no reason to believe that menstrual blood is less irritating than that escaping with tubal pregnancy.

Finally, it is difficult to understand why menstrual blood, thrown into the pelvic cavity, would not cause sufficient peritoneal irritation to produce much more frequent tubal closure. If, as Sampson believes, it is the cause of the marked inflammatory reaction seen in cases of pelvic endometriosis, one would expect, perhaps, a maximum of reaction around the fimbriated ends of the tubes. And yet they are characteristically open. My own impression is that the menstrual blood given off, usually in small amounts, from the ovarian and other

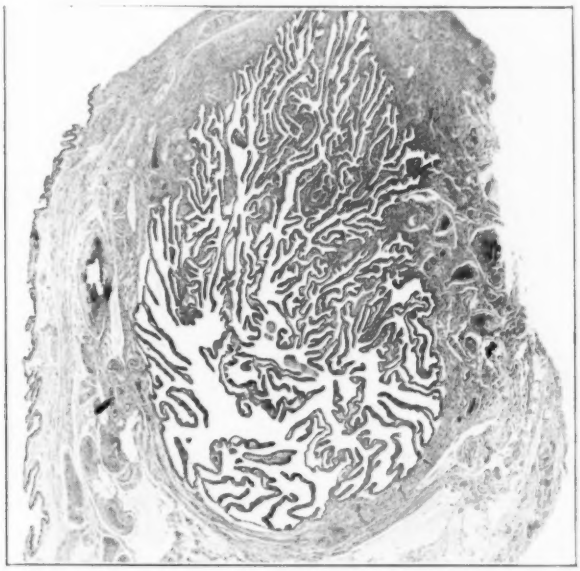

Fig. 13.—Characteristic appearance of tube removed at height of menstruation (section near fimbriated end). This patient had been menstruating freely for twenty-four hours, but no blood is seen in the tube.

islands in the pelvis, does actually cause the adhesions which are so common, and that the tubes are not closed because they not only pour out no blood themselves but are not usually brought into contact with it, when the endometrial islands are small and scattered. When they are larger, as with definite chocolate cysts in the ovary, the fimbriae are often matted over the ovarian surface.

Sampson states that he has occasionally observed menstrual regurgitation through the tubes, and a few other authors have made similar general statements. My search of the literature and my inquiries among surgeons, however, have yielded little or no specific information on this point. Perhaps the experiences of the members of such a society as this may throw some light on this point. The

occasional occurrence of regurgitation cannot be denied, but I am strongly of the opinion that it must be too infrequent to explain such a common condition as endometrial ectopia.

CAN ENDOMETRIAL TISSUE UNDERGO RETROGRADE TRANSPORTATION INTO THE PELVIS?

Even if the liquid menstrual discharge could be carried out into the pelvis, it is not easy to see how solid particles of tissue could follow this route. Nature may make some blunders, but there is surely a definite purposefulness in the propulsion of the tubal contents toward the uterus rather than toward the peritoneal cavity. It is the well-beaten path followed by the ovum, which, if our ideas be correct, is drawn into the funnel by the ciliary current and slowly propelled along the tube by the action of the cilia, with possibly some assistance from the muscular coats of the uterus. The experimental studies of Wislocki and Guttmacher[7] have demonstrated in animals a definite and vigorous peristaltic activity on the part of the tubal musculature, the contraction waves passing from fimbriae to uterus. Only occasionally, even under the abnormal conditions of the experiment, was a slight wave seen going in the other direction. In the human a direct observation on this point was made by Hirschberg.[8] A specimen of tubal pregnancy, just removed from a patient, was placed upon a cold plate. Immediately those present observed a definite peristaltic wave passing from the fimbriated end to the uterine. This was repeated several times.

The most exhaustive study of this question is the very recent one of Kok,[9] whose material consisted of about 140 tubes from cows, sheep, and pigs. Among his conclusions the one which is pertinent to the present discussion is to the effect that peristalsis is almost exclusively toward the uterus, and that antiperistalsis is seen only as the result of a markedly distending foreign body in the ampulla.

Certainly the peristaltic activity of the tube is in no way comparable to that of the intestine. Every surgeon has frequently observed peristalsis in the intestine or ureter, but how many have seen any evidence of peristalsis in the living tubes at operation? So far as I know, no such observation has ever been made. It seems unnecessary to invoke the factor of tubal peristalsis to explain the propulsion of the tiny ovum through the tube. Indeed, the ovum is so small that a muscular contraction wave could hardly get a grip on it. The rôle of the cilia is probably a more important one in this connection.

In addition to the obstacle presented by the essentially one-way traffic through the tubal canal is the obstacle offered at the uterine end of the tube. The studies of Geist and Goldberger,[10] presented before this society last year, have a direct bearing upon this point.

They confirmed the observations of previous workers as to the extreme narrowness of this portion of the tube, the uterine orifice having a diameter often as small as 0.5 mm. and rarely more than 1 mm. Furthermore, this end of the tube is surrounded by a well-developed circular muscular layer, of almost sphincteric type. While this no doubt varies as to its tonicity or relaxation at different times, it seems incredible that it could admit such particles of tissue as, for example, are seen in some of my own sections. They could scarcely thread themselves into such a tiny orifice, especially when the relatively large uterine cavity offers a far easier way out. This is true even in the presence of such conditions as retroflexion or myoma, for I know of no evidence that with the great majority of these there is any great degree of obstruction to the egress of menstrual blood, as Sampson has assumed.

Again, even if particles of mucosa made their way into the tube, they would still have an almost impossible journey through the tubal strait. This, as Geist and Goldberger showed, is a very narrow canal which passes either in a gentle curve (40 per cent) or in an angulated or sinuous manner (60 per cent) through the thick musculature of the uterus.

In short, the tube may be likened to a long funnel. Its wide open mouth readily receives ova or other bits of tissue from the ovary, cancerous particles, etc., and carries them downstream into the uterus. It is not, however, so easy for particles to enter the extremely narrow neck of the funnel and to fight their way upstream to the peritoneal cavity. This essentially one-way mechanism may be looked upon, in part at least, as an agency to protect the peritoneum from intrusion from the outer world by way of the generative tract.

CAN ENDOMETRIUM THROWN OFF AT MENSTRUATION GROW ON THE OVARY OR PERITONEUM?

The effect of the obstacles encountered by tissue passing through the tube in an antiphysiologic direction upon the viability of such tissue must be borne in mind. In the first place, one must not forget that the tissue lost at menstruation has been thrown off to die. This is not a mere assumption, for if there is anything in the histologic interpretation of cell vitality, the fact can be abundantly established by histologic studies of menstruating uteri and of the cast-off tissue recovered from the menstrual discharge.[11] Even before the endometrial layers crumble away, their dissolution is evident from such changes as loss of staining reaction and obliteration of cell outline (Fig. 14). Autolytic changes must be quite active, for it is almost impossible to find more than an occasional indistinct clump of dead cells in the menstrual blood passed per vaginam. If the menstrual blood be taken from the interior of the menstruating uterus

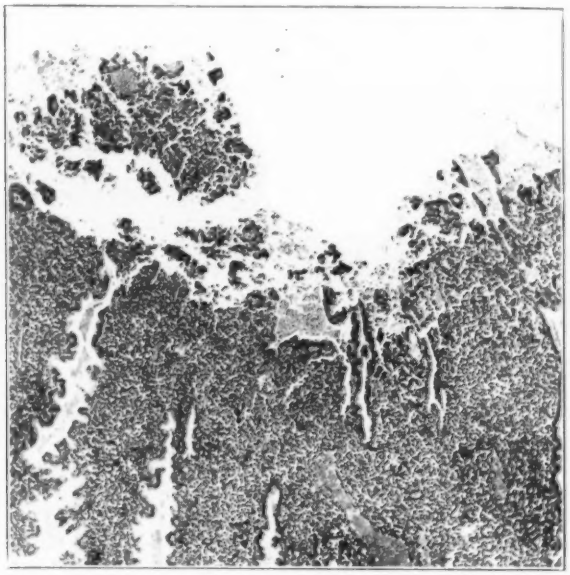

Fig. 14.—Showing the endometrial surface on the first day of menstruation, with characteristic degeneration and crumbling away of the endometrium. It is hard to believe that these degenerated bits, even if they could get into the tube, could retain sufficient vitality after perhaps several days of travel to grow actively in the pelvis, especially when one considers the rapidity of autolytic changes in such tissue.

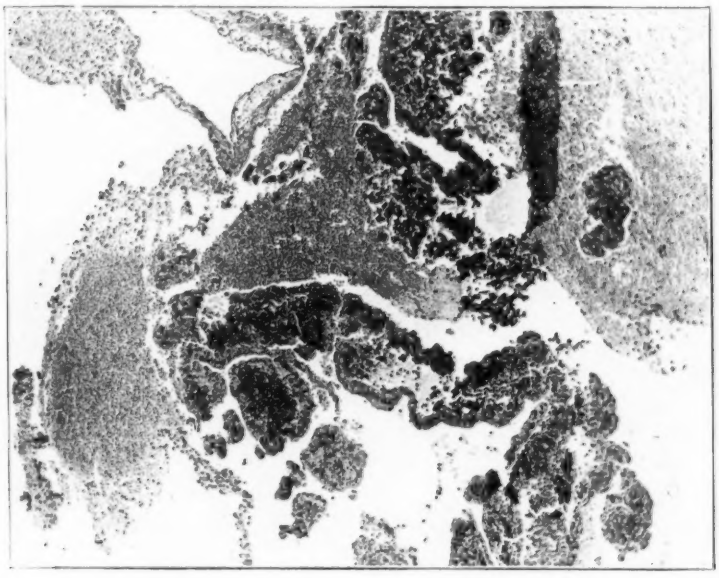

Fig. 15.—Particles of degenerated endometrium recovered from the uterine cavity, immediately after removal of the uterus, on the third day of menstruation. If histologic appearance is any criterion, as it usually is, they have little or no vitality left.

immediately after removal of the latter, somewhat less degenerated portions of tissue may be recovered (Fig. 15). Even at this point it would seem impossible for such dead or dying tissue to grow again. And yet we are asked to believe that such degenerate tissue somehow enters the tube, passes through it against the normal current, and makes its way to the peritoneum, where, in spite of probably many days of continuing degeneration and autolysis, it can still grow where it falls. The ovum requires at least several days for its passage through the tube, although it is much smaller than these supposed endometrial particles, and although it is helped by all the factors which retard the passage of the endometrial tissue.

The statement is commonly made that the ovary is especially suited to implantation of regurgitated endometrium, presumably because of the fact that the rupture of follicles offers ready portals of entry. But the follicles rupture not during menstruation but many days before this, most frequently on about the thirteenth or fourteenth day of the cycle. The area of rupture is soon sealed over, and the ovary observed at operation or studied after removal commonly presents a smooth surface. The question is not analogous to that of the implantation of gastrointestinal cancer on the ovary, for in the latter case we are dealing with a malignant tissue which is ever present and ready to graft itself upon the ovary when a portal of entry occurs.

As regards endometrium, it would seem that the delicate endothelium of the peritoneum would offer a far more inviting medium than the dense and relatively avascular albuginea of the ovary, with its covering of cuboidal epithelium. The fact that the ovary is by far the most common seat of heterotopic endometrium must therefore speak against the doctrine of implantation.

ECTOPIC DIFFERENTIATION OF CELOMIC EPITHELIUM AS A SOURCE OF ABERRANT ENDOMETRIUM

One of the most interesting observations in connection with the presence of endometrial tissue in the ovary is the fact that it exhibits so many variations in both its morphology and its reaction to the menstrual stimulus. One may find a broad expanse of the ovarian epithelium converted into typical uterine epithelium, not infrequently ciliated, with at times only an occasional gland-like invagination and perhaps no stroma whatever, i.e., in the sense of the typical uterine stroma. Such a surface may resemble endometrium of the fetal or infantile uterus. It may or may not show hemorrhage in the subepithelial layer. If it does not, it is often difficult to determine whether it is really to be spoken of as a müllerian type of epithelium. If it does, the suggestion of real endometrium is of course stronger. When a broad area of the ovarian surface is covered with a layer of the type described, with no tendency to penetrate into the ovary or

to grow above its surface, it is difficult to conceive of an implantation origin. The natural assumption would be that a metaplasia of the germinal epithelium has taken place, and that by a very easy and slight transition it has assumed a somewhat endometrial appearance.

In other areas we will see many glandular invaginations from such a surface, but without stroma and without any evidence of menstrual participation (Fig. 16). The general pattern of such pictures is so identical with that seen in the cases of unquestioned endometrial type, that one cannot escape the impression that we are dealing with exactly the same process, the only difference being that in the one instance the epithelium is quiescent and in the other it has, for some

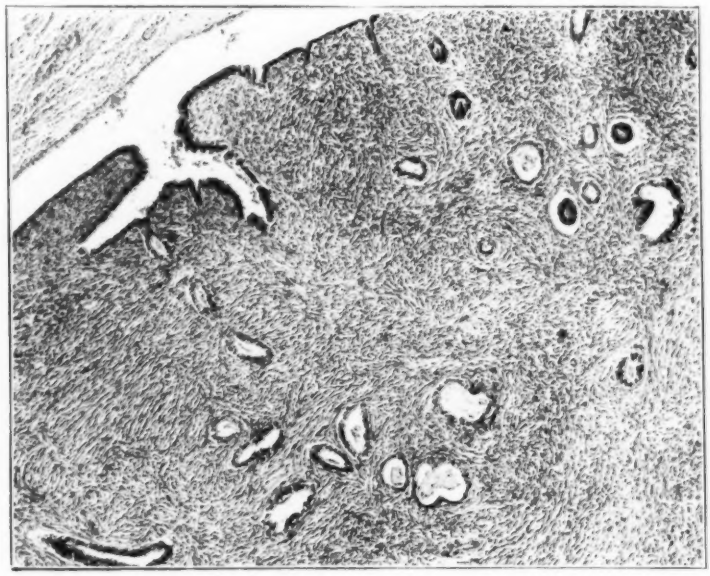

Fig. 16.—Surface of ovary (beneath overlying adhesion), showing typical endometrial gland-like invaginations, with uterine type of epithelium, but no stroma and no evidence of menstrual reactivity. The gland epithelium is directly continuous with what is apparently a slightly modified germinal epithelium. It would seem that this picture represents exactly the same process as that described by Sampson, but in an earlier and less differentiated form. But it suggests a metaplasia, and not an implantation.

reason, acquired a sensitivity to the menstruation-producing hormone or hormones. The histologic picture in this group can scarcely be interpreted as one of simple germinal inclusion cysts of the type which one so often sees, especially in women at or near the menopause.

In still other cases the resemblance to genuine endometrium is much more clear cut, as a result of the presence of the characteristic stroma and perhaps because of the presence of what seems to be a menstrual reaction. At this point I may perhaps suggest that, in my judgment, Sampson has attributed too much importance to the significance of hemorrhage as a criterion of menstruation in ectopic endometrium.

It is important to remember that ovarian epithelium likewise exhibits what is to be looked upon as a normal hemorrhagic tendency. For example, it is normal for the lutein cell zone of the corpus luteum, during the vascularization phase, to exhibit hemorrhage into its cavity. This, of course, will rarely be mistaken for endometrial hemorrhage, but, after all, the lutein cells are merely modified granulosa cells, and the latter, in turn, are considered to be derivatives of the germinal epithelium.

To carry the derivation back even more ultimately, all these types of cells, i.e., germinal epithelium, granulosa cells, lutein cells, and endometrial cells, are descendents of the same mother tissue, i.e., the celomic epithelium. Hemorrhage in and about the graafian follicles, especially those which exhibit atrètic change, is so common that it can scarcely be considered abnormal. Moreover, as I showed in a previous paper,[12] follicular hemorrhage originates in the subepithelial stroma, as with endometrial tissue in the ovary, and then breaks through the epithelium into the cavity. Indeed, some of the the pictures in Sampson's earlier papers seem to me to be more suggestive of follicular than of endometrial origin.

I mention these facts not to argue that Sampson's cases are of follicular or corpus luteum type, for this would be absurd. A proper question, however, would seem to be whether the blood in the lesions which he describes is always given off at the menstrual periods, i.e., synchronously with uterine menstruation. So far as I can recall, no one has described in the ovary a genuinely menstruating endometrium such as we see in the uterus, although it quite probably occurs. In a large number of cases the lesions show blood contained in cavities with intact epithelium, with no suggestion, even when they are removed shortly after menstruation, of the tissue loss and other changes which are so characteristic in the uterus. With so many deeply placed and essentially blocked-off cavities, one would surely expect to see occasional evidences of necrotic tissue elements, such as we find in the uterus, even allowing for rapid degeneration and autolysis. In the ovarian cavities they could scarcely disappear as quickly as they do in the uterus, which permits of prompt discharge to the exterior. In the ovary one most commonly sees blood elements alone, without such tissue changes, even when the ovaries are removed soon after menstruation.

As already stated, it is probable that in some ectopic endometrial islands the changes are identical with those seen in the uterus, but in a large proportion of them it would seem more likely that the bleeding is more closely allied with that seen in the ordinary follicle hemorrhage. Perhaps the bleeding is the result of the premenstrual congestion throughout the pelvic organs rather than of the actual rhexis and diapedesis which occurs at menstruation and which is

accompanied by loss of much of the mucosa. If the bleeding in ovarian endometrium is really menstrual, certainly the histologic reaction is very different from that seen in the uterus, both as to the actual stage of menstruation itself and also as to the regenerative process following the menstrual loss of tissue. In many areas the lining epithelium appears to be a transition between either germinal or follicular epithelium and genuinely endometrial epithelium. This would seem more logical than to say that the differences in the reaction are due to the age of the implants, even if these actually occur.

One often sees in the same ovary areas of endometrium actively responding to the menstrual cycle and, perhaps immediately adjoining them, islands of perfectly quiescent endometrium. Indeed, one often sees pictures which could be reasonably construed as evidences of endometrial transformation of the endothelium of the lymphatics. We have been much interested in this possibility, which I shall not, however, discuss in this paper.

The conclusion which suggests itself from this consideration of the hemorrhagic factor, and also the one which seems logical from a consideration of the differences in the histologic picture of the endometrium in perhaps different parts of the same ovary, is that we are dealing with one and the same tissue in different stages of differentiation, and that these stages are analogous to those seen in the developmental history of the generative epithelium.

It is the celomic epithelium, the covering of the primitive peritoneal cavity, that forms the various epithelia of the genital gland, the germinal epithelium, and indirectly the granulosa and lutein cells. Furthermore, it is this same celomic epithelium which becomes invaginated to form the lining of the müllerian ducts, so that the müllerian epithelium is really only a modified peritoneum. As a result of hormone influences concerning which we are as yet ignorant, this celomic epithelium assumes a different form in different parts of the tract. For example, in the uterus it assumes a gland pattern, more particularly after the onset of puberty, and develops a characteristic stroma. Physiologically, it possesses a remarkable sensitivity to the ovarian hormones.

In the tube, which is chiefly a transmitting organ, it has a more stable structure, characterized by such features as rugae, and absence of glands and stroma. It is not infrequent, however, to observe a confusion in the usually fairly sharp segmental differentiation. For example, I have, in quite a number of cases, seen a fairly typical endometrial mucosa in the fallopian tube at points quite removed from the uterus itself (Fig. 17). Others have made similar observations. For that matter, I have, in a certain proportion of cases, found ectopic mucosa in the ovaries to possess typically tubal features, without glands and without uterine stroma. It may even exhibit a definite

tendency to the formation of rugae. Such mucosa may be found in the interior of an endometrial cyst cavity. In one striking example, the cavity is lined by a mucosa which is definitely endometrial for a part of its extent and then passes rather abruptly into a just as typical tubal mucosa (Fig. 18).

Studies in comparative anatomy may throw some light on this point. Dr. Carl Hartman, of the Carnegie Institute of Embryology, tells me that he frequently finds abnormal epithelial outgrowths on the surface of opossum ovaries, of which he has studied some four hundred. The opossum ovary is not inclosed by the tubal sac, and there is no such thing as menstruation. I am indebted to Dr. Hartman for the two samples pictured in Figs. 19 and 20, which show on the

Fig. 17.—Section of tube wall (with some inflammatory change) showing resemblance to endometrial tissue. Characteristic uterine mucosa lining portions of the tube well removed from the cornu has been described by a number of authors.

surface of the ovary farthest removed from the hilum two aberrant growths, which, in Dr. Hartman's opinion, represent aberrant müllerian mucosa.

It would be just as useless to attempt to explain the reasons for this jumbling of the normal differentiation processes in the genital tract as it would be to offer an explanation for the normal morphologic and physiologic differentiation itself. It is almost certainly the result of hormone influences, and these affect chiefly or entirely the celomic epithelium in the genital gland area. More than this we cannot say. For this reason I do not feel that any one can, in the present state of our knowledge, explain the exact mechanism of production of aberrant mucosa. The celomic theory, which in one form

or another has been advocated by several authors (Lauche,[13] Robinson,[14] etc.), is therefore less a theory than a concept.

It is possible, as some have suggested, that the occurrence of ectopic endometrium at various points in the pelvis is due to the presence of celomic rests in these regions. But it is just as possible that, aside from the "rest" theory, the normal germinal or other epithelium of the ovary, or the normal pelvic peritoneum, may under the proper combination of endocrine and other conditions, be quickened to various differentiation phases abnormal for the tissue concerned.

This is no mere speculation, for embryologists, on the basis of careful observations, accept the view that there is a definite and intimate

Fig. 18.—Wall of endometrial cyst in the interior of the ovary, showing endometrium-like portion of wall above, and typically tube-like portion below, one being continuous with the other.

relation between all the epithelial tissues arising from any one of the embryonic layers. Each one of the original embryonic layers possesses developmental potentialities, which, for various organs, are limited at various stages as a result of certain physical or chemical factors, either local or general. It thus is evident that the potency of the cells is not used up, so that if, in later life, the same conditions arise which are responsible for the original development of the cells in question, they may be activated into new growth. For example, a germinal epithelial cell retains a considerable degree of unused developmental potency, and with the proper activation, can develop further into an endometrial or tubal epithelial cell. The same statement may be made of the pelvic peritoneum. What the activating

conditions are we cannot say, except that they are almost certainly of endocrine nature. As already stated, these views are not merely speculative, for, as Fischel[15] has emphasized, they have considerable support from embryologic studies.

Applying this conception to the subject matter of this paper, one can readily understand why such an intimate relationship exists between the cells of the pelvic peritoneum, the germinal epithelium, the tubal mucosa, and the endometrium, for they are all descendents of a common mother tissue, the celomic epithelium of the urogenital folds. In this sense the endometrium and the endosalpinx are to be looked upon as merely a modified peritoneum, or a modified germinal epithelmium, so that it is not so startling to think that either peritoneum

Fig. 19.—Abnormal outgrowth from the surface of an opossum ovary. It arises from the convex surface of the ovary, as far as it could well be from the hilum. Its structure resembles that of a tubal fimbria. For this section, and that illustrated in Fig. 20, I am indebted to Dr. Carl Hartman, of the Carnegie Institute of Embryology, who tells me that such abnormal outgrowths are not infrequent in the ovarian surface of these animals, which do not menstruate.

or germinal epithelium, plus the necessary but as yet unknown biologic activating stimulus, may give rise to more or less typical müllerian mucosa. It is possible that inflammatory or other disease of the pelvic organs may at times play some part in stimulating the ectopic differentiation of the reproductive epithelium, but this does not seem to me to be a very important factor. There is little real evidence in support of the view that inflammation, per se, can bring about an endometrial metaplasia of other pelvic epithelium, although it is possible that it may play a contributory rôle in some cases.

A consideration of possible importance lies in the fact that the activating hormones are probably found in the ovary itself, and that

the frequency of germinal epithelium metaplasia may perhaps be due to its proximity to the source of supply of the hormone—that perhaps there is a greater intensiveness of endocrine action in the ovary itself than in more distant tissues.

This conception of pelvic endometriosis explains all types and all locations of ectopic endometrium in the pelvic peritoneum, ovary, the uterine ligaments, the intestinal wall, the appendix, the abdominal wall, the umbilicus, the inguinal region, the vulva, etc., for in all these locations celomic tissue or remains may be found. This statement cannot be made of Sampson's theory of implantation from tubal regurgitation of endometrial particles, as will be emphasized later in this paper.

Fig. 20.—Another ovarian outgrowth from the surface of an opossum ovary. It is very similar to that shown in Fig. 19.

The theory of ectopic celomic differentiation, moreover, explains the frequency with which one finds, perhaps in the same ovary, all the developmental stages through which the genital epithelium passes—peritoneum, germinal epithelium, tubal mucosa, and endometrial tissue, either functionating or nonfunctionating.

The latter point, i.e., as to whether or not ovarian endometrium gives evidence of menstrual reaction, is one of especial interest. I do not agree with Sampson that this depends upon the age of the "implant." Very often nonreacting endometrium may be seen deep in the substance of the ovary, so that it can scarcely be considered "young," while superficially placed tissue may show definite menstrual reactivity. A clue as to the real reason for these differences

may be obtained from a study of the menstrual reaction of the uterine endometrium proper. Its upper layers, corresponding to the compact and spongy layers of the decidua, participate actively in the characteristic histologic changes of the menstrual cycle. The deepest layer, the basalis, is unchanged throughout the cycle, and it is from this layer that regenerative changes proceed when the upper strata are lost at menstruation. In the condition known as hyperplasia of the endometrium, the entire mucosa is made up of what is apparently an enormously overgrown basalis, as Martzloff and I have shown in a recent paper.[16] Such an endometrium shows no cyclic change, being stationary in structure. Polypi of the endometrium at times spring

Fig. 21.—Uterine polyp with structure of functioning endometrium, showing same phase as latter. Such a polyp probably arises from the more superficial and functioning layers of the endometrium. This figure, and the one following, illustrate the stratum reaction of the endometrium, especially as regards menstrual reaction, hemorrhage, etc. This may explain some of the variations observed in endometrium as it occurs in the ovary.

from the basal layer, herniating through the upper functioning layers. Such polypi show the typical swiss-cheese pattern of hyperplasia, even though the endometrium proper exhibits a definite menstrual reaction (Fig. 21). They do not respond to the menstrual stimulus at all. Other polypi apparently arise from the functioning layers of the endometrium, and histologically exhibit the same menstrual phases as the latter (Fig. 22). In the same way, a downgrowth of uterine mucosa, as in the uterine type of adenomyoma, shows similar variations as to menstrual reaction. Some of the endometrial islets in the depths of the uterine wall show histologic pictures exactly corresponding to that seen on the uterine surface, premenstrual when the latter is

premenstrual, postmenstrual when the latter is postmenstrual, etc. Others, again, show a characteristic hyperplasia pattern, and several authors have called attention to the frequency of association of hyperplasia with adenomyoma. Such islands are explainable by the fact that they spring from the basal layer of the endometrium, just as do certain uterine polypi.

The endometrium is thus seen to possess a distinct stratum reaction, and this same stratum reaction is likewise evidenced in the ovary. Some of the ovarian endometrium, even when composed of typical epithelium and equally characteristic stroma, shows no evidence of functional response, even though near-by areas show marked

Fig. 22.—Uterine polyp presenting typical hyperplasia-like pattern, and probably springing from basal layer of endometrium. The remainder of the uterus shows usual cyclical changes, and menstrual history was normal. Polypi of this stationary structure are at times seen even when the remainder of the uterine mucosa shows a marked premenstrual hypertrophy.

menstrual reaction. In one remarkable specimen which I had the opportunity to study through the kindness of Dr. R. A. Watkins, of Portland, Oregon, a spongy mass of tissue removed from each ovary shows a uniform and extreme hyperplasia picture (Fig. 23). There is, of course, not the slightest suggestion of menstrual reaction, nor would any be expected. This case is interesting from another standpoint. If this hyperplastic endometrium had its source in a tubal regurgitation from the uterus, the mucosa of the latter would presumably have had the same structure. But hyperplasia of the endometrium is not associated with the monthly desquamative process which is supposedly necessary to liberate the particles into the tubes.

It presents a stationary picture, for no matter at what chronologic phase such an endometrium is removed, the picture is always essentially the same. Certainly there is no evidence of necrosis or surface loss of tissue. Unfortunately, no uterine tissue was available for study in this case. The presence of the endometrial hyperplasia in the ovaries of this case is not readily explainable on the regurgitation theory, unless one wishes to assume that the implantation had occurred a considerable time previously, and that the implanted endometrium then underwent hyperplastic transformation. This, of course, is theoretically possible.

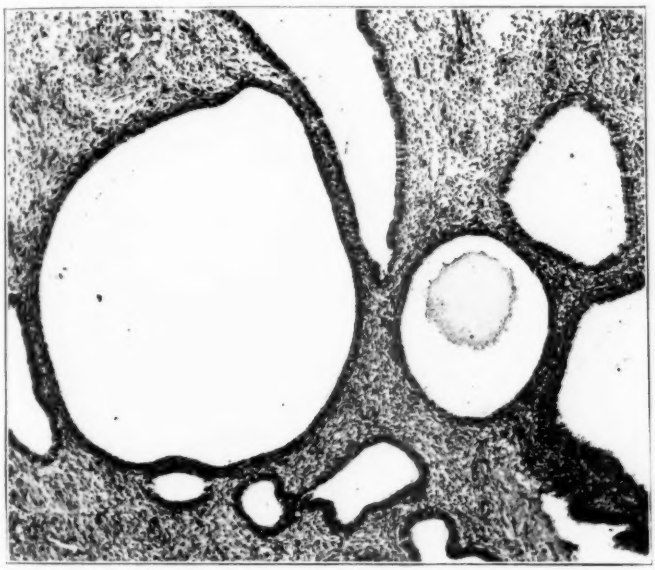

Fig. 23.—A section from a spongy mass of endometrium removed from each ovary, by Dr. R. T. Watkins, of Portland, Oregon. Although the masses were large, they showed no sign of menstrual hemorrhage, nor would any be expected, as hyperplastic endometrium does not react to menstruation. Nor does it undergo periodic destructive change, so that the presence of this tissue in the ovaries cannot be explained on the tubal regurgitation theory, unless we assume that it became hyperplastic after implantation. This, of course, is theoretically possible.

The differences in the morphology and functional capacity of aberrant endometrium are, I believe, most plausibly explained upon the basis of differences in the degree of differentiation, remembering that endocrine factors may not only bring about segmental differences, but also stratum abnormalities, especially in the case of the endometrium.

One other point in this connection may be touched upon, for it has caused much discussion. I refer to the origin of the stroma (the "cytogenous" tissue of the German school). Not believing in the uterine origin of ovarian endometrium, I do not, of course, believe that the stroma of ovarian endometrium is bodily transplanted from the uterus by way of the tubes. It has always seemed to me that it

must be formed in situ. This is indicated by the fact that one can often demonstrate transition stages of one degree or another between the endometrial stroma and the native stromal cells of the tissue involved, as well as by the fact that perfectly characteristic stroma is to be seen in such distant locations as the umbilicus, where its origin by transplantation is not easily explainable.

The recent paper by Fischel, already quoted, while dealing with the relationships of epithelium and connective tissues in general rather than with the problem presented in ectopic endometrium, emphasizes a point of view which, to my mind, explains our problem logically and in conformity with our histologic studies. Fischel presents good evidence to substantiate his conclusion that developmentally the epithelium plays the dominant and formative rôle, the connective tissue the subordinate one. The stroma of the endometrium is to be looked upon as a satellite tissue and its appearance is the natural accompaniment of the presence of celomic epithelium which has reached a certain stage of differentiation.

DOES IMPLANTATION PLAY ANY PART IN PELVIC ENDOMETRIOSIS?

One of the strongest arguments brought forth by Sampson to support the implantation theory of pelvic endometriosis has been the fact that, in laboratory animals at least, endometrial tissue is capable of growth when transplanted to the pelvic peritoneum. The earlier experiments of Jacobson[17] upon this subject seemed to me rather unconvincing, and even his most recent work, which was done upon monkeys, cannot be taken as proof of the correctness of Sampson's theory. It is hardly necessary to emphasize the differences which exist between the sexual cycles of the lower animals and the human female. In none of them below the primates does menstruation occur in the sense in which we employ the term in the woman, although a number of them exhibit a periodic discharge of blood. This, however, commonly occurs during the period of proestrum and not during the period of actual sexual desire or estrus, as many appear to assume. Moreover, it is well known that the chronologic relation of ovulation to menstruation in the human is quite different from that which it bears to estrus in most of the lower animals which have been studied.

The most serious objection to the work of Jacobson and others who have studied endometrial transplantability in its application to pelvic endometriosis appears to me to lie in the fact that the tissue which they have transplanted is active, virile, and well-preserved, while the endometrial tissue thrown off in human menstruation is just the opposite, as I have already emphasized. If it were possible successfully to transplant to the ovary and peritoneum the degenerating endometrium of the menstruating uterus, the bearing of this method of study upon the problem would be much greater than it

now is. Even then, as we shall see, it would offer no proof of the hypothesis of tubal regurgitation. Such experiments are out of the question in the human subject, while heterotransplantation of human material into animals would offer little hope of success.

Tissue cultural methods, were they applicable to the endometrial tissue cast off at menstruation, would seem to be a desirable means of study, but they, likewise, as I am told by those more familiar than I with the technic, would be predestined to failure.

Even granting the essential applicability of Jacobson's studies to the human problem, what do they demonstrate? Only that endometrial tissue can be successfully implanted upon the pelvic peritoneum. They throw no light upon the source of the endometrium in human endometriosis. The arguments brought forth to fix the source as the uterus, by way of the fimbriated end of the tube, have to deal chiefly with the distribution of the "implants" in the pelvis. All of the evidence applies equally well—or better—to the ovary as a source of the dissemination. If the tube actually permitted a monthly regurgitation of blood and endometrium, it would seem that the pelvis of every woman with any ectopic endometrium at all would be filled with the tissue. Since the same conditions exist from month to month, the regurgitation would, according to this theory, also be regularly repeated. In view of the supposed proliferative tendency of the ectopic endometrium, one would expect extensive endometriosis in every case. This, of course, is not borne out by experience, for as a rule, the amount of ectopic tissue is very slight, the condition being often of no great clinical significance.

There are further facts which indicate that implantation alone can scarcely explain the origin or spread of the condition. The ectopic endometrium is not always situated at the points of predilection emphasized by Sampson. The relation of the tube to the ovary and of both to other pelvic viscera has always seemed to me to be much less stereotyped than one would gather from Sampson's diagrams. I have recently observed a case in which only one tiny endometrial islet was found in the pelvis, and that was on the anterior surface of the rectum, well above the level of the adnexa. Careful inspection of the ovaries, which were not removed, showed not the slightest suspicion of endometrial tissue. Another circumstance indicating that the abnormal tissue is not the mere result of gravitation of particles of endometrium from the tubal os to the most dependent parts of the pelvis is seen in the cases which have been reported by Keene[18] and others of extensive endometrial involvement of the vesicouterine pouch, or of the anterior surface of the uterus.

It must be remembered also that a tiny particle of tissue set free in the pelvis would not tend to sink like a ball of lead to the bottom of the pelvis or to the bottom of a hernial pouch. It would behave

more like a tiny feather and adhere to the first peritoneal surface with which it came into contact.

Pelvic endometriosis has been explained as analogous to cancer in its implantability on the peritoneum. But a pelvic cancer does not always confine itself to the pelvis. It is often soon disseminated throughout the abdominal cavity, vegetations extending over the whole parietal wall, the intestines, and often the stomach, liver, and other upper abdominal organs. This is never seen even with the most extensive pelvic endometriosis, which remains, to all intents and purposes, a strictly pelvic lesion. Mere peritoneal implantation, if concerned at all in the process, is certainly not the only factor in the spread of the condition. There must be some special susceptibility of the pelvic peritoneum to this endometrial implantation or differentiation, as the case may be.

As already stated, the evidence brought forth by Sampson in favor of the tubal dissemination theory applies even more forcibly to the ovary as a source of the dissemination. In other words, if implantation is an important factor—as it quite possibly is—it is more probable that the seed is dropped from the near-by ovary, with its better preserved endometrium, than from the end of the tube, which could transmit only a very degenerate tissue from the distant uterine cavity. In the case of the ovary, the tissue thrown off need not be the seat of menstrual degeneration. It may be actively growing endometrium which is thrown out by the rupture of hematomata, or which is broken off from the ovarian surface. A glance at Fig. 3 is rather suggestive in this respect. Would it not be easier for such polypoid outgrowths to break away from the ovary, even without the influence of menstruation, than for a portion of either menstruating or nonmenstruating endometrium to be separated by even the most violent pressure through the thick-walled uterus, as by bimanual examination, an occurrence which Sampson suggests as very possible?

The possibility of such a breaking off of ovarian endometrial tissue is well seen in Fig. 24, which shows a large particle of fairly well-preserved, nonmenstruating endometrium lying apparently free in an endometrium-lined cavity, which no doubt communicated from time to time with the general pelvic cavity.

The same reasoning applies to the supposed dissemination of uterine cancer through the lumina of the fallopian tubes to the ovary. My own impression is that this means of spread is of negligible importance, although the general implantability of cancer tissue is unquestioned. Cancer of the ovary is relatively rare as a complication of adenocarcinoma of the uterine body. Norris[19] found it in only 2 of 115 cases. When it does occur, it is far more logically explained as due to the generally recognized channels of dissemination, i.e., the lymphatics. Sampson argues that the rarity of ovarian metastasis is

explained by the accepted fact that fundal carcinoma most frequently occurs in women beyond the menstruating age. In quite a number of cases, however, adenocarcinoma occurs during the menstrual period of the woman's life. In Norris' 115 cases, for example, 15 were below forty years of age, and 18 were between forty and fifty. Most of the latter group were no doubt still menstruating, and yet only 2 of the entire series of 115, many of which he states were far advanced, showed extension to the ovary. The ages of these patients, and whether or not they were still menstruating, are not given.

In most cases of body cancer, the tumor mass bleeds rather constantly, simulating more or less the hemorrhage of menstruation. Fig. 25 is from an ovary removed with a uterus which was the seat of ad-

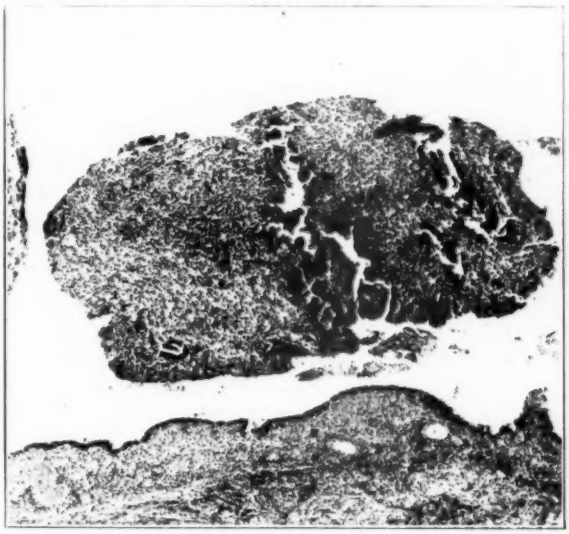

Fig. 24.—A particle of endometrial tissue cast off from and lying in the cavity of an endometrial cyst, which no doubt communicated with the exterior of the ovary. Endometrial tissue thrown off in this way from the ovary may make its way into the tube, or it may, conceivably, be implanted on the pelvic peritoneum.

vanced adenocarcinoma, with a long history of bleeding, at times very free. The interior of the uterus presented a fungating, foul-smelling, ulcerated mass of cancer tissue. No evidence of cancer was found in either ovary, but, as the illustration shows, definite endometrial tissue was found deep in the ovarain substance. I believe that the endometrium is present because it was formed in situ, during the woman's reproductive life, and that cancer was not found because it did not pass out from the uterine cavity, even though the latter was jammed full of it. It would not be logical to argue that the cancer closed the uterine orifices of the tubes, because such propinquity would seem to make it easier for bits of tissue to break away into the tubal lumina.

In one of his papers, Sampson presents illustrations of two sections in which cancer tissue is found lying free in the tubal lumen. But in both these cases cancer was present above the point at which the cancerous tissue was found in the tubal lumen. In one there was a cancer of the body of the uterus associated with a cancer of the same type in the distal end of the fallopian tube. The cancer particles were found in the tube between the tubal cancer and the uterus, so that it would be wholly unjustified to assume that they were passing out from the uterus instead of toward it, from the tubal cancer. His other case offers an exactly similar explanation. It was one of extensive disease of the uterus, which Sampson thought probably a coexisting adenocarcinoma and sarcoma. The pelvis was full of im-

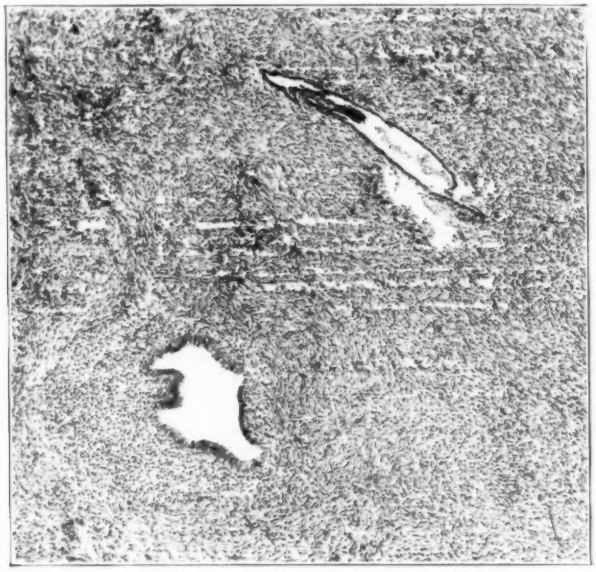

Fig. 25.—Section of ovary from a patient with extensive ulcerating adenocarcinoma of the uterus. No cancer is found in either ovary, but endometrium can be demonstrated. If endometrium could be transported, why not also cancer, when the uterus is filled with bleeding cancer tissue?

plantations, all of the supposed sarcoma type. Bits of growth, similar to the latter tumor, were found free in the lumen of one tube. In both these cases the tubes were patent, and I submit that there is no reason whatsoever for assuming that the tumor particles are migrating in the abnormal upward rather than in the normal downward direction.

Fig. 26 illustrates the findings in the tube of a recent interesting case. The patient had a right ovarian cyst about the size of a coconut. It was smooth externally, but its wall showed definite cancerous changes. The left ovary was normal, but the left tube showed a definite elongated nodule in its wall. It was evidently a cancer, and microscopically it showed a structure like that of the ovarian cancer.

The left tube was closed and the cancerous cyst showed no external growth, so that the tubal growth must have been due to lymphatic dissemination. Proximal to the tubal cancer, the lumen shows large fragments of cancer, but the uterine edometrium is perfectly normal, with no trace of cancer.

One other interesting group of cases may be very briefly alluded to—those of supposed operation scar implantation. A number of these have been reported, though this condition must still be looked upon as relatively rare. The reports of Heaney[20] and of Danforth[21] before this Society last year indicated that scarcely more than a dozen cases had been reported in the entire literature up to that time. Only a few have been reported since then.

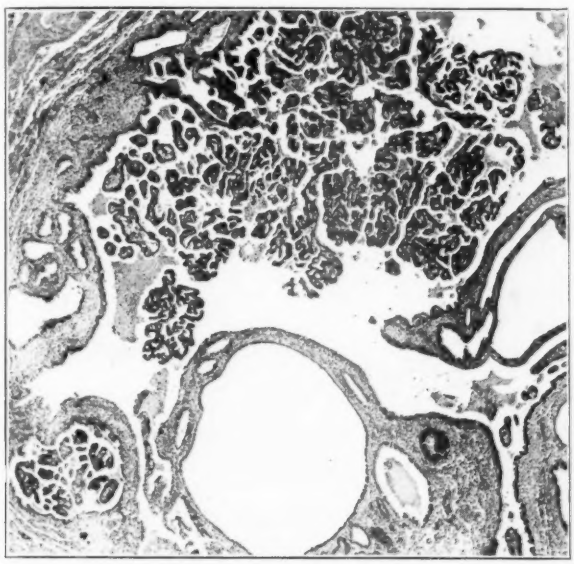

Fig. 26.—Tube showing large particles of cancer tissue in the lumen. The patient had a cancerous ovarian cyst on the right, although there were no external vegetations. The left ovary was normal, but the left tube wall showed an elongated nodule of carcinoma, presumably a metastasis by way of the lymphatics, as the end of the tube was sealed off. The large mass of cancer tissue shown in the lumen, exactly similar in type to that seen in the ovary, may be attached at some point to the tube wall; but it is easy to see how particles could break off and pass down toward the uterus. This is apparently borne out by the appearance of the smaller mass seen in the tubal alcove to the right. A uterine origin is excluded, for the uterine cavity shows no trace of cancer.

When the lesion occurs, it can scarcely be overlooked, for it often gives rise to much discomfort. Nor, in the past few years, is it apt to have been misinterpreted by any surgeon at all conversant with the literature which has been set in motion by Sampson's contributions. Hence the statement that it must be considered infrequent is justified, especially when one bears in mind the enormous number of operations performed each year in which the endometrial cavity is opened—hysterectomies, cesarean sections, etc. If these scar tumors

were produced by simple transplantation of endometrium, would we not be justified in finding them much more frequently than we do? Moreover, in an increasing number of cases, as in a recent one of my own, such endometrial tumors in abdominal scars are being reported in cases in which the uterine cavity is not in any way opened. Pankow[22] has recently briefly reported a case in which simple appendectomy had been performed upon the patient when she was a child, presumably before menstruation began. At the age of thirty a tumor developed in the scar, and on removal, ten years later, it contained typical endometrial tissue. I do not see how we can invoke the doctrine of transplantation in such a case. A number of other cases have been reported in which the uterine cavity was not opened at the original operation.

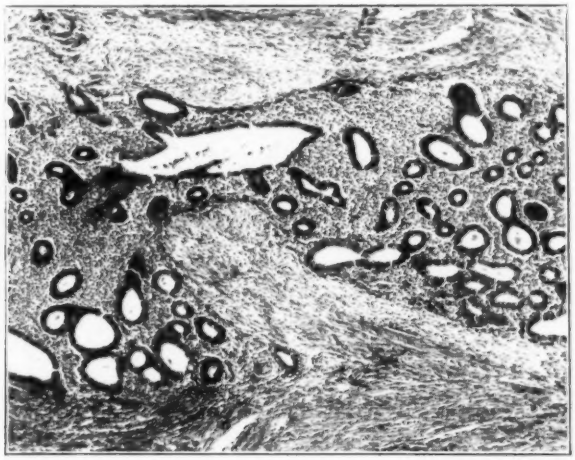

Fig. 27.—Typical endometrium in a nodule located in an abdominal cicatrix following an operation five years previously. This previous operation consisted in left salpingo-oophorectomy with pelvic drainage. The nodule was very tender but the patient stated that there was no increase in size or in pain at the menstrual periods. It contained much endometrium, but practically all of it was of the quiescent, hyperplasia type seen above. Only a few glands were found to contain blood, and no chocolate areas were seen.

I do not believe that there is yet sufficient evidence for the assumption that these cicatrix endometriomas are due to actual transplantation of endometrial tissue, especially in the cases where the uterus is not entered at the operation. On the other hand, I do not believe that this possibility can be denied, especially as we are here dealing with a virile, well-preserved endometrium. The arguments which have been set forth in this paper appear to speak for the possibility of the origin of such growths from the celom-derived peritoneum, as with similar growths elsewhere on the peritoneum. Perhaps the irritative effect of the cicatricial process may play some part in stimulating this ectopic differentiation process. Even the umbilicus is, of course, to be looked upon as a cicatrix, while in addition it often

contains remnants of the omphalomesenteric duct, which is lined by celomic epithelium.[23]

It is interesting to note that the endometrium in these abdominal scars and umbilical tumors may show marked variations in morphologic, as well as peritoneal, differentiation, such as were emphasized in the discussion of the ovarian lesion. For example, they do not always swell or cause increase of pain at the menstrual periods, as I had occasion to note in the recent case alluded to above (Fig. 27). In this case, the endometrium, while present in large amount, shows little evidence of existing or preexisting menstrual activity, although the growth had been present two years.

SUMMARY

The present study is based upon the histologic study of many hundreds of fallopian tubes, with particular reference to their contents. In seven tubes particles of uterine mucosa were demonstrated lying free in the lumen, and in one tube, which contained a pregnancy in its outer third, there was, between this point and the uterus, a mass of cells which resemble trophoblastic or possibly decidual cells. The nature of the endometrial particles, when these were found, is, I believe, indisputable in practically all the cases. None of the women from whom these endometrium-containing tubes were removed was menstruating, most of them being many days removed from this period. Five of the seven tubes containing endometrium were removed on the twenty-sixth, fourteenth, eighth, tenth, and ninth days of the cycle, respectively. In Case 2 there had been slight irregular bleeding for two weeks, but the endometrium was of the typical interval variety. In Case 7, in which tuberculous salpingitis was present, there is also said to have been a slight, dark reddish discharge for seventeen days. The uterus had not been removed in this case, so that we can say nothing as to its histology. In the cases in which the endometrium was available for study this was seen to be in a nonmenstruating phase, with an intact surface. In none of the cases did the endometrium in the tubes show the characteristic picture of endometrium thrown off at menstruation.

In at least five of the cases the particles of free endometrium are so large that it would seem almost impossible for them ever to have entered the tiny uterine orifice of the tube. The suggestion that they are probably moving toward rather than away from the uterus is strengthened by the finding of definite endometrial tissue in the ovary in at least two of the cases. The failure to find it in some of the other cases may be due in several instances to the fact that little or no ovarian tissue was removed at operation, and is possibly explained in one case by the frequent difficulty in finding small islands

of ovarian endometrium in specimens which have been in a fixing fluid for a considerable time.

Does Menstrual Blood Regurgitate?—A considerable number of observations (thirteen) in the course of operations upon women who were menstruating at the time and whose tubes were open failed to show regurgitation of menstrual blood in a single case. This experience corresponds to that of a number of other surgeons with whom the author has discussed the subject. Histologic examination of tubes removed during menstruation characteristically shows little or no blood. No blood has apparently been observed in the pelvis in the thousands of women operated upon by thousands of surgeons immediately after menstruation, although it could scarcely be resorbed so quickly if any had escaped into the pelvis. Even if occasionally blood did escape from the tube at menstruation, it is difficult to exclude pathologic lesions of the tube. If menstrual blood escapes into the pelvis, it is hard to see why it does not cause symptoms of peritoneal irritation similar to those seen with tubal abortion, or why it does not more often cause sealing off of the tubes. The latter are commonly open. The conclusion from these various facts is that although menstrual regurgitation through the tube may occur, it is exceedingly infrequent, too infrequent to explain such a very common lesion as pelvic endometriosis.

Can Endometrial Tissue Undergo Retrograde Transportation into the Tube?—The physiologic direction of travel through the tube is that taken by the ovum, i.e., from above downward. The ciliary current is probably more important than muscular peristalsis. Antiperistalsis is probably rare, and, according to recent investigations, occurs only in conditions of overdistention of the tube. The uterine orifice of the tube measures only 0.5 to 1.0 mm., so that it seems almost incredible that it could admit such large particles of tissue as are seen in some of my cases, especially with a far easier avenue of escape open through the uterus. There is no evidence that there is menstrual blockage in most cases of retroflexion or myoma, any more than it is now believed to occur with anteflexion. Furthermore, endometriosis is often found with normal uteri. Even if an endometrial particle made its way into the uterine os of the tube, it would still have an almost impossible passage through the very fine lumen of the interstitial tube, which passes in a gently curved or sinuous fashion through the thick musculature of the uterus. The tube is to be likened to a funnel, whose wide mouth readily admits ova, endometrial or cancer particles, but whose narrow end and neck will neither admit nor transport them very easily.

Can Endometrium Thrown Off at Menstruation Grow on the Ovary or Peritoneum?—If it takes the smaller ovum a number of days, at least, to pass down the tube, even with the current at its back, it

would probably take much longer for tissue to pass upward against the stream, assuming that this were possible. But histologic studies show that the tissue thrown off at menstruation is dead or dying. Can such degenerative tissue thread itself into the tubal orifice, make its way upward against the obstacles which have been described, and, after probably many days, still have sufficient vitality to grow where it falls? This would seem incredible, especially as autolytic and degenerative changes are very rapid in the cast-off tissue of menstruation. There is no evidence that the ovary, except at the time of ovulation, offers any especial portal of entry for "implantations"—and ovulation is almost as far removed from menstruation in point of time relation as it can be. At other times the ovary is commonly smooth, with a dense fibrous albuginea covered by the cuboidal germinal epithelium. And yet, although theoretically less favorable from this standpoint than peritoneum, it is much more commonly the site of "implantations." Indeed, Sampson suggests that it acts as a sort of intermediary host. For the reasons I have just mentioned, it would seem that the susceptibility of the ovary to endometrium-like transformtaion must be explained in some other way than upon the basis of simple implantation.

Ectopic Differentiation of Celomic Epithelium as a Source of Aberrant Endometrium.—If aberrant endometrium is not derived from the uterine mucosa by transportation through the tubes, what is its source? No one can speak dogmatically on this point in the present state of our knowledge, but I have offered evidence in support of the view that the explanation may perhaps best be sought by reference to the normal developmental history of the genital epithelia. All are derived from the celomic epithelium of the urogenital folds. Not only does this form the germinal epithelium of the ovary and the follicular epithelium, but it also becomes invaginated to form the lining of the müllerian duct. The endometrium and the endosalpinx are therefore to be looked upon as mere modifications of the peritoneum. It is therefore not surprising that either peritoneum or germinal epithelium may at times show endometrial transformation. The factors which determine the normal regional differentiation of the celomic epithelium are as yet unknown, though almost surely of endocrine nature. It is a well-known embryologic law that tissues derived from the same embryonic mother epithelium are closely related. Furthermore, the developmental potentialities of celomic epithelium which has reached the stage of germinal epithelium are not used up, to apply the embryologic generalization laid down by Fischel. It is still capable, with the proper activating influence, of going on to further differentiation into endometrium or endosalpinx.

This idea is borne out by the fact that one may see in ovarian endometriosis all the stages of differentiation through which the genital

epithelium normally passes, e.g., simple endometrium-like epithelium with few or no invaginations and little or no stroma; more typical endometrium with or without menstrual reactivity; mucosa resembling that of the tube, etc. The mere presence of hemorrhage cannot be taken as evidence of menstrual participation of epithelium. Other epithelia in the ovary, as I have indicated, show a physiologic hemorrhagic tendency. The various histologic pictures mentioned above as occurring in the ovary are probably different stages of the same process, representing merely different stages of differentiation, both morphologic and functional, as I have discussed in this paper. A possible factor in the activation of germinal epithelium is the fact that the hormones of the ovary itself are probably the ones most concerned, and that they exert a much more intensive influence upon the local ovarian tissues than upon more distant ones.

The above ideas as to the origin of aberrant endometrium are offered as a concept rather than an explanation of the lesion. Until we know more about the normal processes of development we shall probably be unable to explain this abnormal condition with any precision.

Does Implantation Play Any Part in Pelvic Endometriosis?—The studies of Jacobson would seem to indicate that in animals endometrium can be made to grow on the peritoneum, but they throw no light on the source of aberrant endometrium in cases of pelvic endometriosis. The significance of this work is lessened by the fact that the endometrium transplanted was active and virile instead of degenerated, as in the case of the menstrual endometrium in women.

Against the all-importance of implantation in the dissemination of endometrium in the pelvis, several facts may be mentioned: (1) The endometrium is not infrequently found chiefly, and perhaps exclusively, in parts of the pelvis, or elsewhere, where implantation from the tube would not be easy; (2) it is often present in extremely small amount, in spite of the supposed monthly regurgitation and the proliferative tendency of the tissue; (3) it is characteristically confined to the pelvis, even when extensive endometriosis is present, unlike cancer, which can implant itself over the entire abdominal cavity. All in all, the evidence indicates that if implantation plays a part in the dissemination of the endometrium, as it well may, it is the ovary from which the seed is primarily dropped rather than the tube. All the reasons urged by Sampson in favor of the tubal origin of "implants" speak just as forcibly, and indeed much more so, for the ovary as the primary source. Endometrial tissue from the ovary would theoretically possess much greater vitality than that from the menstruating uterus, for it could readily break off from the surface or be cast out in the rupture of hematomata, without the influence of menstruation.

No evidence which has yet been advanced would seem to demonstrate that retrograde transportation of cancer particles from the uterus is a factor of any great importance in the explanation of ovarian metastasis in adenocarcinoma of the fundus. The complication is very infrequent. The two cases in which Sampson found cancer particles in the tubal lumen have no signigficance in this connection, because in each case there was a cancerous growth above the free tubal particles, which were thus probably making their way from the growth toward the uterus. I have reported a similar case in this paper. This, at any rate, is the natural assumption, and the burden of proof would seem to be placed upon those who presuppose such an unnatural and difficult-to-explain process as retrograde transportation of tissue from the uterus.

The cases herein reported of endometrium passing through the tubes, as well as all the others in the literature, show a nonmenstruating endometrium which is explainable in only one of two ways. It may be passing from the ovary to the uterus, as I believe is indicated by some of my own cases and also by the single case which Sampson pictures in one of his articles. If, on the other hand, it is being transported in a retrograde manner, certainly this migration has nothing to do with menstruation in these or in any other cases which have been reported in the literature. It would have to be explained as due altogether to such factors as the squeezing of the uterus at operation or examination. But I do not believe that anyone would attempt to explain in this way more than a very small proportion, if any, of the numerous cases of endometriosis encountered clinically.

I should like to acknowledge my indebtedness to Drs. Thomas S. Cullen, George L. Streeter, and Carl Hartman, for valuable suggestions. The photomicrographs are the work of Mr. Herman Schapiro.

REFERENCES

[1]Sampson: Arch Surg., 1921, iii, 245; Am. Jour. Obst. and Gynec., 1922, iv, 451; Arch Surg., 1922, v, 217; Boston Med. and Surg. Jour., 1922, clxxxvi, 445; Surg. Gynec. and Obst., 1924, xxxviii, 287; Am. Jour. Obst. and Gynec., 1925, x, 1.
[2]Corner and Amsbaugh: Anat. Rec., 1917, xii, 287.
[3]Jägeroos: Ztschr. f. Geburts. u. Gynäk., 1912, lxxii, 28.
[4]Lahm: Centralbl. f. Gynäk., 1926, l, 720.
[5]Cordua: Centralbl. f. Gynäk., 1926, l, 720.
[6]Schmid: Centralbl. f. Gynäk., 1925, xlix, 44.
[7]Wislocki and Guttmacher: Bull. Johns Hopkins Hosp., 1924, xxxv, 246.
[8]Hirschberg: Centralbl. f. Gynäk., 1924, xlviii, 858.
[9]Kok: Arch. f. Gynäk., 1926, cxxvii, 384.
[10]Geist and Goldberger: Surg. Gynec. and Obst., 1925, xli, 646.
[11]Novak and TeLinde: Jour. Am. Med. Assn., 1924, lxxxiii, 900.
[12]Novak: Bull. Johns Hopkins Hosp., 1917, xxviii, 349.
[13]Lauche: Arch. f. Path. Anat., 1923, ccxliii, 298.
[14]Robinson: Surg. Gynec. and Obst., 1925, xli, 36.
[15]Fischel: Wien. Klin. Wchnschr., 1922, xxxv, 355.
[16]Novak and Martzloff: Am. Jour. Obst. and Gynec., 1924, viii, 385.
[17]Jacobson: Arch. Surg., 1922, v, 281; Arch. Path. and Lab. Med., 1926, i, 169.

[18]Keene: Am. Jour. Obst. and Gynec., 1925, x, 619.
[19]Norris: Am. Jour. Obst. and Gynec., 1924, vii, 550.
[20]Heaney: Am. Jour. Obst. and Gynec., 1925, x, 625.
[21]Danforth: Am. Jour. Obst. and Gynec., 1925, x, 630.
[22]Pankow: Monatschr. f. Geburts. u. Gynäk., 1925, lxxi, 361.
[23]Cullen: The Umbilicus and Its Diseases, Philadelphia, 1916, W. B. Saunders Company.

26 East Preston Street.

(*For discussion see page* 623.)

A CONTRIBUTION TO THE STUDY OF ENDOMETRIOSIS*

By Carl Henry Davis, M.D., F.A.C.S., and Roland S. Cron, M.D., F.A.C.S., Milwaukee, Wisconsin

THE purpose of this report is to place on record nine cases of heterotopic endometrial tissue, some of which illustrate the possible origin and mode of production of certain endometrial implants. Sampson, Graves, Cullen, Danforth, Heaney, Keene and Norris have reported before the American Gynecological Society the finding of endometrial-like tissue in all of the pelvic organs, along the intestinal tract, and in the postoperative scar of the abdominal wall following operations in which the uterine cavity was opened. Many others have reported similar findings.

The frequency of this condition is not generally appreciated by surgeons because the lesions, especially the smaller ones, are not recognized. Sampson, who is looking for these implants in every pelvis, found them in 98 out of 332 operations for pelvic disease in a single year. Thus far the symptomatology and preoperative differential diagnosis has not been established, and the students of the subject are not agreed regarding the origin of some heterotopic endometrial tissue. Our series, while small, is offered with the hope that it will aid in establishing endometriosis as a clinical entity and in the admission that minor pelvic manipulations or operations may at times be responsible for its occurrence.

ENDOMETRIAL IMPLANTS PROBABLY DUE TO TRANSUTERINE INFLATION

The following case is believed to be of more than usual interest.

Case 1.—Mrs. A. H., aged twenty-nine years, was first seen by C. H. D., February 2, 1925. She complained of sterility, dysmenorrhea, lumbosacral backache, bearing down sensations and moderate leucorrhea. Her periods were regular 28 day type, lasting 6 days with moderate pain which was worse on the second day. Her appendix had been removed in 1916. In January, 1924, a glass tube had been inserted after a dilatation and curettage, but as she did not become pregnant other physicians inflated the tubes in April and October, 1924, and in January,

*Read at the Fifty-first Annual Meeting of the American Gynecological Society, Stockbridge, Mass., May 20, 21 and 22, 1926.

1925. Through a misunderstanding the last inflation was done seven days after the beginning of the period instead of seven days after it stopped. Each time the gas passed easily according to reports.

Examination showed that the uterus was sharply retroflexed and low in the pelvis. The adnexa were prolapsed into the culdesac. The cervix showed chronic endocervicitis and moderate erosion. The cervix was cauterized, the uterus replaced and a suitable pessary inserted.

The cervical condition healed within six weeks. She was relieved of most symptoms within a few days after the first examination and treatment, but when the pessary was removed the retrodisplacement promptly recurred and with it the pelvic discomfort and backache. She finally agreed to operation in October, 1925.

Operative Findings: The tip of each tube was adherent to the uterosacral ligament on its side. On freeing these adhesions there remained granular-like tissue along the area of adhesions which resembled bits of endometrial tissue (Fig. 1). These were removed, leaving an oozing peritoneal surface. The lumen of the tubes appeared larger than usual, and the ovaries were apparently normal.

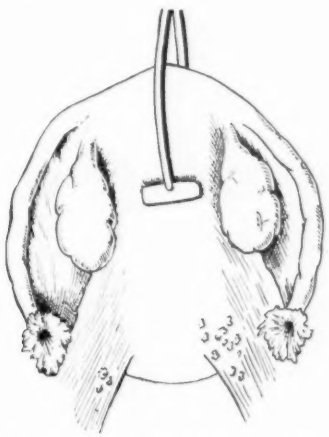

Fig. 1.—Case 1. Tip of each tube found adherent to uterosacral ligament on its side. Granular-like tissue found along area of adhesions at base of uterosacral ligaments.

Pathologist's Report: The sections show many small pieces of tissue having typical structure of hyperplastic endometrium. Some of the glands contain blood and degenerated blood, others a homogeneous material, and a few are filled with polymorphonuclear leucocytes (Fig. 2).

The most interesting part of this record is the treatment which she had for sterility, and the fact that the third inflation was done the morning after the cessation of menstruation. Accepting Sampson's observations and Jacobson's experiments on rabbits as proof that many endometrial implants are the result of normal endometrium escaping through the tubes, this case illustrates three possible etiologic factors. First, by an increased intrauterine pressure during menstruation in the presence of retroflexion with or without a tight internal os, droplets of blood and endometrial tissue are forced through patent tubes, as has actually been observed by Sampson. This possibility is supported by the work of Novak and TeLinde which showed that the endometrium is cast off in strips and bits during the

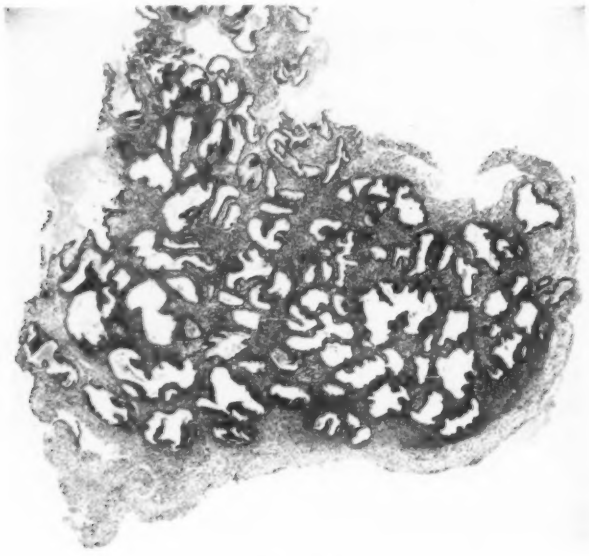

Fig. 2-A.

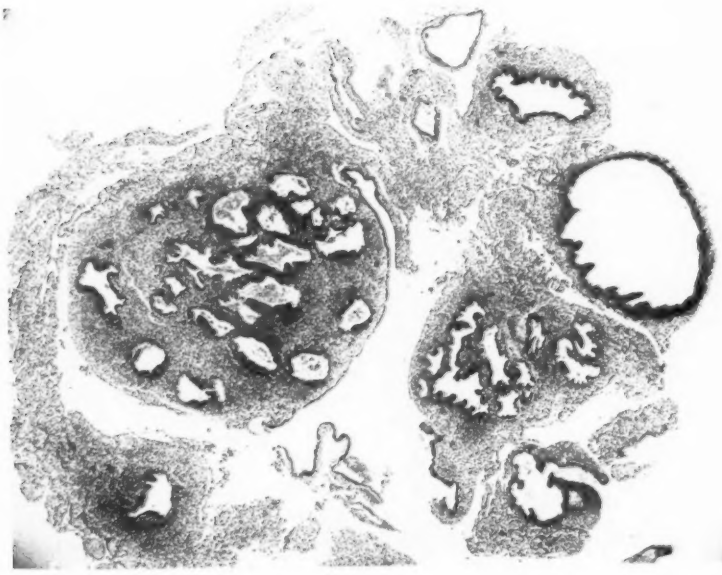

Fig. 2-B.

Fig. 2.—Case 1. *A* and *B* (x 25) show size and type of the granular tissue which was removed. *C* and *D* show higher magnifications. This tissue is typical of endometrium and is believed to have been forced out through the tubes during a tubal inflation. (See *C* and *D* on next page.)

first few days of the menstrual period. Second, tissue is forced through tubes by manual manipulations of the uterus at the end of menstruation, or following intrauterine manipulations, such as dilata-

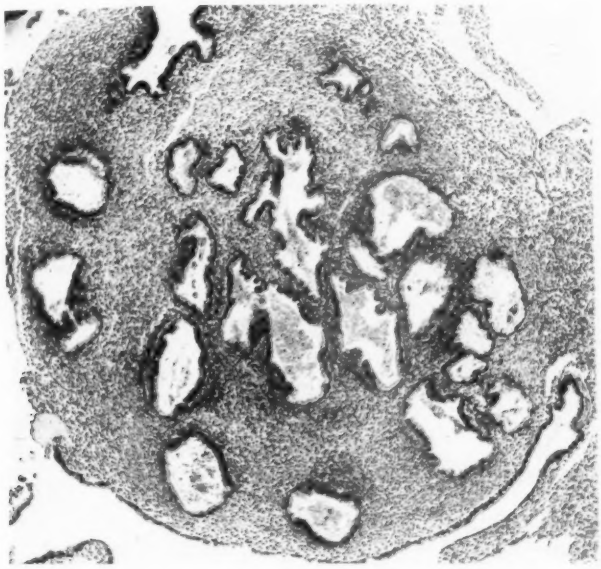

Fig. 2-*C*.

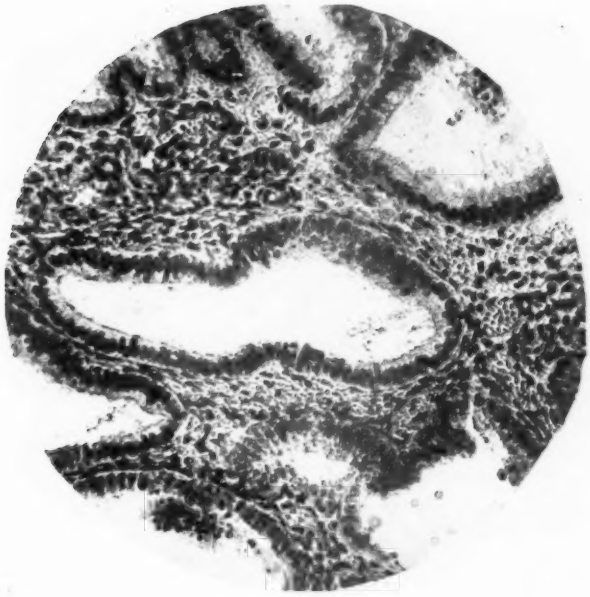

Fig. 2-*D*.

tion and curettage; and thirdly, by the injection of air or carbon dioxide through the uterus and out the tube or tubes. One of us (R.S.C.) has actually seen droplets of bloody fluid forced out of the fimbriated end of the tube during a laparotomy when carbon dioxide

was being introduced according to the Rubin technic. In the above case it is possible that bits of free endometrial tissue remaining in the uterus, or dislodged by the intrauterine cannula, may have been forced through the prolapsed tubes and grafted onto the peritoneum along the attachments of the uterosacral ligaments.

ENDOMETRIAL IMPLANT INVOLVING POSTERIOR VAGINAL VAULT

CASE 2.—Mrs. T. A., aged thirty-eight years, was first seen by R. S. C., September, 1925. Menses had always been scanty. Following an anterior shortening of the round ligaments, in 1915, she became pregnant but aborted at two months. In

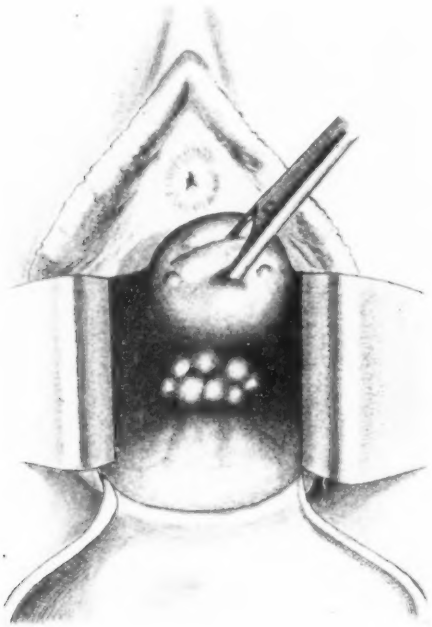

Fig. 3.—Case 2. Blue dome cysts (endometrioma) of vagina just posterior to cervix—filled with chocolate-colored material and surrounded by considerable induration which extended into the posterior culdesac.

1918, she had amenorrhea for four months before an attack of influenza. Following this illness the periods were very profuse. At that time the late Dr. Studdiford cauterized some Nabothian cysts on the cervix and treated her for anemia. She enjoyed good health during the next six years. Late in 1924, she developed pain in the vaginal vault during coitus. A few months later she began to have more profuse periods with the recent development of flooding and large clots. There has been nausea but no pain with the menses.

Pelvic examination showed that the cervix was conical in shape, pointed posteriorly and its mobility definitely restricted by a moderately tender, indurated mass the size of a hickory nut, just posterior to the cervix in the posterior fornix. This area could not be visualized with the speculum, but manipulation caused bleeding, and a tentative diagnosis of carcinoma of the vagina was made and radium treatment advised.

The induration was confirmed when the patient was examined under anesthesia, and just posterior to the cervix, six or eight small bluish cysts were seen in the vaginal wall (Fig. 3).

Operation: The curettings were normal. Incision of the cystic areas in the posterior fornix of the vagina showed them to be filled with a chocolate colored material. Rather active venous bleeding necessitated suturing. In view of the history of menorrhagia and the location of the lesions which were then recognized as blue dome cysts (endometrioma) 100 mg. of radium in the form of needles in the cysts and a capsule in the cervix were left for a total of 2150 mg. hr.

Microscopic examination of the tissue removed from the cystic area showed no malignancy but a typical endometrioma (Fig. 4).

Fig. 4.—Low power microphotograph of blue dome cyst (endometrioma) as shown in Fig. 3 (Case 2). Normal squamous cell mucous membrane of the vagina is present except over the cystic area where the cyst wall approaches the surface. The cyst is lined by ciliated columnar epithelium as are a number of the other gland spaces, all of which are surrounded by typical endometrial stroma. Some of the gland-like spaces contain blood and a homogeneous material. The patient also had a chocolate cyst of the right ovary.

Examination of this patient six months after radium treatment showed a slight slough on the posterior lip of the cervix and considerable shrinking of the lesion. There has been a continuous slight discharge and recently a small amount of bleeding.

In a discussion before the American Gynecological Society last year, Cullen described a case in which the gross appearance was similar to this one. The cases of vaginal endometriosis studied by Sampson were all located in the vault of the vagina posterior to the cervix, and were directly continuous with a peritoneal endometriosis in the posterior culdesac. In this case it is our belief that the growth started as an endometrial implant on the peritoneum of the culdesac. (Since this paper was written, her abdomen was opened and a chocolate cyst of the right ovary found.)

ENDOMETRIAL IMPLANTS ON UTERUS

CASE 3.—Mrs. M. H., aged thirty-five years, was first seen by C. H. D., December 31, 1925. Her chief complaint was dysmenorrhea which kept her in bed from one to three days each month and was only relieved by hypodermics. There had been more or less pain since her first period, but it had become much more severe during the past two years. An acute appendix and the left adnexa had been removed in 1912.

Operative Findings: The omentum is adherent along the old incision and over the top and right side of the uterus. The uterus is irregularly enlarged with multiple fibroids. The left adnexa are missing. There is a tuboovarian abscess on the right side. Operation: Freeing of omental adhesions, subtotal hysterectomy and right salpingo-oophorectomy.

Pathologic Examination: The uterus contains an intramural fibromyoma about 6 cm. in diameter in the posterior wall and several smaller ones are scattered through the musculature. Along the line of omental attachment are seen two puckered areas about 2 cm. long and 1 cm. wide. These apparently penetrate to a depth of about 1 cm. The uterine cavity shows no gross pathology. The tube and ovary make a single mass about 10 cm. long and 5 cm. wide and show a typical picture of tuboovarian abscess.

Microscopic Examination: Sections from three blocks of uterine wall near serous surface in puckered areas show typical endometrial tissue. Sections of the ovary show subacute inflammation. Sections of the fibroid show typical picture of fibromyoma. No evidence of endometrial tissue is found in any of the sections taken from the ovary.

CHOCOLATE CYSTS OF THE OVARY

Five patients had chocolate cysts of one or both ovaries. Their histories and findings are briefly recorded.

CASE 4.—Miss E. B., aged forty-six years, was first seen by C. H. D., September 18, 1922. Her chief complaints were frequent profuse periods with tendency to clots, severe dysmenorrhea, attacks of right sided pain and moderate leucorrhea. Recto-vaginal examinations: Uterus is markedly retroverted, moderately enlarged and nodular. Left adnexa negative to palpation. The right adnexa are enlarged and tender.

Operative Findings: On opening the abdomen the omentum is found attached to the anterior right wall of the abdomen along the line of Poupart's ligament with dark areas and the appearance of a mass under it. On separating the omentum it is found that the right round ligament is involved in the right sided mass which apparently developed from the spill of a chocolate cyst of the right ovary. The sigmoid and ileum are attached by firm adhesions to the pelvic mass. The entire right pelvis is filled with a tuboovarian mass and attached to the wall by dense adhesions. The uterus is small, retroverted and contains multiple small fibroids. The left ovary is enlarged and contains cysts. There are old adhesions in the upper abdomen. The gall bladder is markedly distended and does not empty on pressure. The kidneys are normal to palpation. The appendix is thickened but free from adhesions. Operation: Freeing of omental and intestinal adhesions, panhysterectomy, appendectomy, repair of injured areas in bowel wall, ignicauterization of chocolate areas on intestines, and plastic covering of the raw pelvis with the sigmoid. Two weeks later the gall bladder was removed. The microscopic examination showed typical endometrial cysts of the ovary. The patient made an uneventful recovery and is now in good health.

CASE 5.—Miss E. K., aged forty-seven years, was first seen by C. H. D., June 18, 1924. Her first period at the age of fourteen was so painful and profuse that the foot of her bed had to be elevated. She always had to remain in bed one or two days, and as she grew older the periods became profuse to the point of real hemorrhages. She began to flow April 29, 1924, and with the exception of two weeks had a daily flow until the time of operation. The preoperative diagnosis based on history and pelvic findings was probable chocolate cysts of ovary and adenomyomata of the uterus, with secondary anemia.

Operative Findings: The uterus contains multiple small fibroids. Both ovaries are enlarged and contain typical chocolate cysts. The left ovary is about three inches in diameter. There are dense adhesions between the ovaries and the uterus. The rectum is adherent to the lower portion of the uterus. The culdesac is obliterated by dense adhesions. Operation: Subtotal panhysterectomy, appendectomy, and plastic covering of the pelvis with the sigmoid to prevent adhesions between the small intestines and the raw pelvis.

Microscopic Examination: The sections of the ovary show typical findings of chocolate cyst of the ovary and that from the adherent parts of the uterus also shows typical endometrial tissue. This patient made an excellent recovery, and there was a gradual atrophy of the thickened area where the rectum was adherent to the cervical portion of the uterus.

CASE 6.—Miss E. M., aged forty-five years, was first seen by C. H. D., July 22, 1925. Her only complaint was enlargement of the lower abdomen. The uterus was enlarged by a fibroid tumor which filled the pelvis and extended upwards to the navel.

Operative Findings: Large pedunculated fibroid of the uterus with twisted pedicle and secondary adhesions to the rectum and sigmoid, multiple small fibroids of the uterus. The right ovary contains a typical chocolate cyst, and there is a right sided parovarian cyst 5 by 7 cm. in diameter. Operation: Subtotal panhysterectomy and repair of injured bowel. She had a smooth convalescence and with the exception of hot flashes has enjoyed good health since the operation.

CASE 7.—Miss P. M., aged forty-six years, first seen by C. H. D., March 29, 1926, because of moderate menorrhagia and metrorrhagia since September, 1925. Her periods began at the age of 15 and had been regular 28 day type, lasting five to six days until the beginning of the present trouble when she began to bleed on alternate weeks. They were painful from the first, but for some years the pain had not been as regular and was usually less severe. Operation was advised because of pelvic findings and history.

Operative Findings: The uterus is retroverted and contains small intramural fibroids. The left adnexa are prolapsed into the culdesac and the left ovary, which is enlarged to about 5 by 6 cm., is held by dense adhesions. The right adnexa seem normal. The appendix is thickened but free. Examination of the upper abdomen is negative. Operation: Panhysterectomy and appendectomy. In freeing the left ovary the chocolate cyst was ruptured. It was found that there were secondary implants which involved the rectal wall extending moderately into the rectovaginal septum. Palpation of this area on rectal examination led us to suspect the true nature of the condition before operation. No attempt was made to remove the tissue from the rectal wall as our experience agrees with that of Graves and Sampson that these areas atrophy after the ovaries are removed. The sections from the wall of the ovary show typical endometrial tissue.

CASE 8.—Mrs. A. S., aged twenty-two years, first seen by C. H. D., March 5, 1924. Chief complaints were sterility and dysmenorrhea. The pain starts before the onset of the period and lasts until after the flow stops. This has been much

worse since an appendectomy in 1922. At operation it was found that the enlargement of the ovaries was due to bilateral chocolate cysts. Both ovaries were resected and the left tube removed. Her condition was improved, but within a year she reported painful and prolonged menstrual periods. Her present condition is not known. The sections of tissue from both ovaries show typical endometrial tissue.

ENDOMETRIOMA POSSIBLY OF EMBRYONIC ORIGIN

CASE 9.—Mrs. J. E. R., aged thirty years, was operated in September, 1924, by R. S. C., because of a retroversion with prolapsed and adherent ovaries. The uterus and ovaries were found to be fairly normal in gross appearance, but on the left tube a bluish-colored rounded area about ¾ cm. long and ½ cm. wide was discovered on the median surface at about its middle. Believing this to be an endometrioma the tube was resected and the tissue examined. The sections show typical endometrial tissue on the wall of an otherwise normal tube. There is no

Fig. 5.—Case 9. Low power microphotograph showing heterotopic endometrial tissue in the wall of an otherwise normal fallopian tube. Some of the gland-like spaces contained red blood cells. Serial sections showed no connection between the lumen of the tube and the gland spaces. This is possibly of embryonic origin.

evidence found in serial sections of a connection between the lumen of the tube and the heterotopic endometrial tissue, and the peritoneum was apparently intact on the peritoneal side. (Fig. 5.)

The ovaries were not available for microscopic examination but they did not show any macroscopic lesions suggestive of endometriomata. Last year Sampson stated that he had "strong presumptive, almost positive, evidence that benign endometrial tissue at times metastasizes through the lymphatics." While the possibility of such an origin cannot be eliminated in this case it seemed probable to us that it developed from a remnant of embryonic müllerian duct. Dr. Sampson, however, has examined the sections and believes this endometrioma started as an implant on the tube with subsequent growing over of the peritoneum.

The association of fibromyomata with heterotopic endometrial tissue has been rather constant in the older women in our small series. We have noted this association in a goodly number of the cases re-

ported by Sampson and others. It is possible that there may be some relation between disturbed function of the ovary and the development of fibromyomata. The sterility which is so common with both fibromyomata and endometriosis may be due to an abnormal condition of the ovaries rather than to obstruction of the tubes.

In a study of the menstrual histories of these cases one must be impressed by the fact that the periods have been painful from the first in an appreciable number. This may prove an important fact in the final analysis of etiology. It may eventually be shown that certain ovaries contain rather large embryonic inclusions of endometrial tissue which caused pain from the first period and eventually resulted in chocolate cysts. The spill from such cysts could lead to the development of secondary growths in the culdesac or on the uterus. It is also possible that the pain of the first period may have resulted from a very tight internal os and that this associated with a possible congenital retrodisplacement of the uterus resulted in the escape of endometrial tissue through the tube and the subsequent growth in a recent corpus luteum with the later formation of chocolate cysts.

A careful study of our findings and the literature on endometriosis has led us to agree with those who believe that at present no one theory will explain all. In our first case there can be no question that the tissue removed from the uterosacral ligaments was transplanted uterine mucosa. Sampson has many cases in which the transplant theory cannot be questioned, and we accept his observations as evidence that most endometriomata are transplants derived originally from uterine mucosa. In many instances, however, it may be impossible to prove that the primary endometrioma started from an embryonic inclusion or from transplanted uterine mucosa. The end-results may be the same.

REFERENCES

Cullen, T. S.: Tr. Am. Gynec. Soc., 1925, l, 245.
Danforth, W. C.: Am. Jour. Obst. and Gynec., 1925, x, 630.
Ewing, J.: Tr. Am. Gynec. Soc., 1925, l, 243.
Graves, W. P.: Tr. Am. Gynec. Soc., 1925, l, 211.
Heaney, N. S.: Am. Jour. Obst. and Gynec., 1925, x, 625.
Jacobson, Victor C.: Am. Jour. Obst., and Gynec., 1923, iii, 257.
Keene, Floyd E.: Am. Jour. Obst. and Gynec., 1925, x, 619.
Novak, E., and TeLinde R. W.: Jour. Am. Med. Assn., 1924, lxxxiii, 900.
Sampson, J. A.: Am. Jour. Obst., and Gynec., 1925, x, 649 (gives complete bibliography).

141 Wisconsin Street. (*For discussion see page* 623.)

THE RELATION BETWEEN THE TREATMENT OF CANCER OF THE CERVIX AND THE CELL TYPE*

By Frank A. Pemberton, M.D., Boston, Mass.

CANCER of the cervix is being classified histologically according to the predominating type of cell and attempts are being made to find out whether or not these types respond to different methods of treatment.

The two main classes are squamous and adenocarcinoma. The squamous carcinomas may be further subdivided. Schmitz[1] recognizes unripe basal cell and squamous cell types. Martzloff[2] describes fat spindle, transitional, and spinal cell types. The fat spindle cell corresponds to the cells of the deepest layers of squamous epithelium and is long and comparatively broad. The transitional cell corresponds to the cells of the middle part and is round, has a faint cell outline, and a nucleus that stains well. The spinal cell is similar to the cells of the outer layers, it being polyhedral in shape with a well defined cell membrane and a moderately staining nucleus. We understand that the unripe basal cell of Schmitz corresponds to the fat spindle cell of Martzloff, and the squamous of Schmitz includes the transitional and spinal of Martzloff. We have used Martzloff's classification because we believe the three types of squamous carcinoma and the adenocarcinoma can be distinguished and they appear to vary to some extent in their reaction to treatment.

Of 131 cases of carcinoma of the cervix treated at the Free Hospital for Women between Jan. 1, 1917, and Jan. 1, 1924, there are 96 which have full pathologic and follow-up records. These cases were collected and the slides gone over by Dr. R. H. Smithwick, and then the slides were gone over by the reader before knowing Smithwick's results and the two compared. There were a few differences of opinion as to the proportions of the cells in any one case but the predominating type was always agreed on. The method of classification seems reasonable therefore. The tissue contained all three types of cells in most cases.†

The cases were classified by estimating the approximate proportion of the different types of cells in the microscopic section and including that case in the class of the predominating cell type. This is not mathematically accurate but appears to be a working basis. There

*Read at the Fifty-first Annual Meeting of the American Gynecological Society, Stockbridge, Mass., May 20, 21 and 22, 1926.

†Another paper is to be published by Dr. Smithwick on this series of cases which will cover some of the clinical aspects; the type of case suitable for treatment by operation or by radium; the time to use radium, the dosage of radium; and especially the difference in the treatment of scirrhous and soft tumors.

is some variation in the proportions in slides taken from different parts of the same tumor, but in general a predominating cell type can be determined. In only 15.6 per cent of the cases was a single type of cell found.

The results tabulated with those of other writers are seen in Table I.

TABLE I

PERCENTAGE OF EACH CELL TYPE IN THE TOTAL NUMBER

	SPINAL	TRANSITIONAL	FAT SPINDLE	ADENO-CARCINOMA
Martzloff 387 cases	15.5	66.8	12	5.4
Pomeroy & Strauss[3] 75 cases	49	28	8	15
Free Hospital for Women 96 cases	30	56	6	8

There is some variation in the different proportions which we cannot account for on any other basis than a personal equation in classifying the type of cell.

Most cases of squamous carcinoma present a combination of the different types but there are some which appear to be pure. Martzloff[2] found 29.6 per cent of his total were pure and we found 15.6 per cent as shown in Table II.

TABLE II

	SPINAL	TRANSITIONAL	FAT SPINDLE	PER CENT OF ALL CASES
Martzloff	3.6	21.4	4.6	29.6
Free Hospital for Women	6.2	9.3	0.0	15.6

Here again there is a considerable difference in results but we can at least conclude that most cancers of the cervix are not of a pure cell type.

We have tabulated our cases by their gross extent according to the classification devised by the Harvard Cancer Commission. Group A cases have the disease confined to the cervix; in Group B cases the disease has spread to the vaginal wall or body of the uterus; in Group C cases the parametrium is invaded; and in Group D cases there is fixation of the organ, or distant metastases, such as those in the iliac glands, are found.

The predominating type of cell in each group was then tabulated giving the results shown in Table III.

TABLE III

	SPINAL	TRANSITIONAL	FAT SPINDLE
A	36	48	16
B	Not enough cases.		
C	31	64	5
D	40	53	7

From this we may conclude that the proportion of the different cell types is about the same despite the extent of the disease. There is a suggestion that the older the growth is the more it inclines towards the transitional and spinal cell type.

In order to get an idea of the relative malignancy of the different types we have classified the cases according to the length of life under treatment because it seemed as if this would give a better idea of the relative malignancy than the time between treatment and recurrence. It is very difficult to decide when a recurrence appears as the case may not be seen often enough and it may be suspected some time before it is definitely proved. We have used averages of the length of life of the cases to draw conclusions from. The cases in each tabu-

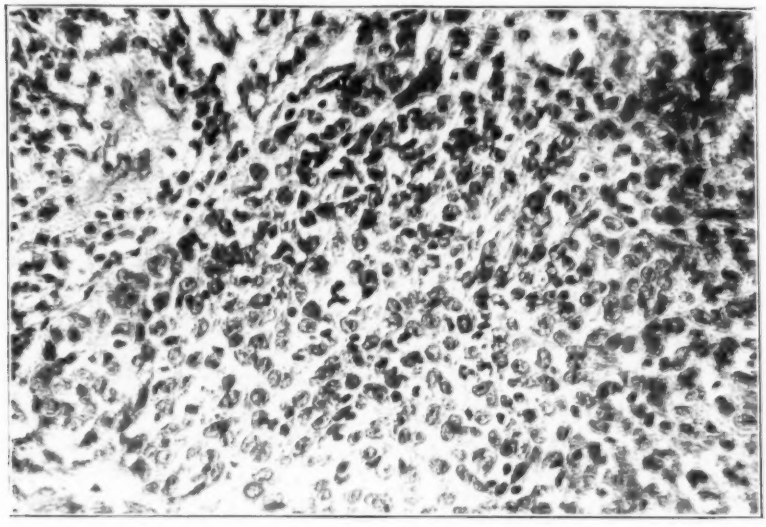

Fig. 1.—Transitional cell type, high power. The nearly circular nuclei and faint cell membranes are characteristic features.

lation are in the same group as regards the clinical extent of the disease and the treatment and, although there are other factors, such as the age and general condition of the patient concerned, it still seemed as if the conclusions would be of value. The cases were treated in different ways so we have had to tabulate them according to the class and treatment.

Nineteen cases including cases of each group, A, B, C, and D, treated by hysterectomy and radium have been omitted in the following tabulation because there was not enough uniformity of treatment to make a comparison with the rest of the cases valuable. Five had radium before operation, four after operation, and ten had radium for recurrences. Two group B cases treated by radium alone have also been omitted, being too few in number.

The five group A cases treated by radium alone which are living show this:

Average for	whole group		52.8 months.
Spinal	2 cases	average	55.5 "
Transitional	3 "	"	51.0 "

One group A case treated by radium alone was of the transitional type and died at nine months.

The seven group A cases treated by hysterectomy which are living show this:

Average for	whole group		64.4 months.
Spinal	2 cases	average	73.5 "
Transitional	3 "	"	59.5 "
Fat spindle	1 case		53.0 "
Adenocarcinoma	1 "		72 "

Of eight group A cases treated by hysterectomy, which have died, three may be considered operative deaths. The other five give this tabulation:

Average for	5 cases		21.2 months.
Spinal	2 "	average	63.0 "
Transitional	2 "	"	9.5 "
Fat spindle	1 case		23.0 "

There were 38 C cases treated by radium alone all of which are dead, except one which is living and well at 42 months, and was of the spinal type. The average life of those dead was 12.6 months, but when they are divided according to the cell type, we find this:

Spinal	11 cases	average	15 months.
Transitional	22 "	"	11.9 "
Fat spindle	1 case		21.0 "
Adenocarcinoma	3 cases		11.0 "

The D cases treated by radium alone number 10 and all are dead at an average of 10.7 months. One lived 57 months, and seven lived 6 or less. According to type they give the following results:

Spinal	5 cases	average	5.8 months.
Transitional	3 "	"	21.0 "
(1 lived 57 months, the other 2 averaged 3.5)			
Adenocarcinoma	2 cases	average	7 "

There are six cases three of group C and three of group D, which were treated by hysterectomy alone which give the following:

Average for	whole group	28.5 months.
Spinal 1		12 "
Transitional	5 cases average	31.8 "

In each table except the D cases and the inoperable cases treated by hysterectomy the spinal type show a greater length of life than the transitional. In the D group an exceptional case living 57 months

raises the average of the transitional, but the average of the other two cases is only 3.5 months. In the C and D cases treated by operation there is only one spinal type and conclusions cannot be drawn from it. There are not enough fat spindle type cases to draw any conclusions from.

It may be concluded that the spinal type is the least malignant and is a more favorable type to treat than the transitional regardless of the kind of treatment. The adenocarcinomas came between the spinal and transitional. The predominating type of cell is not an index as to whether radium or operation is the better treatment because the same type in both groups shows the same comparative results.

Martzloff,[2] and Pomeroy and Strauss[3] agree that the spinal cell type is the least malignant, and gives the best results with treatment.

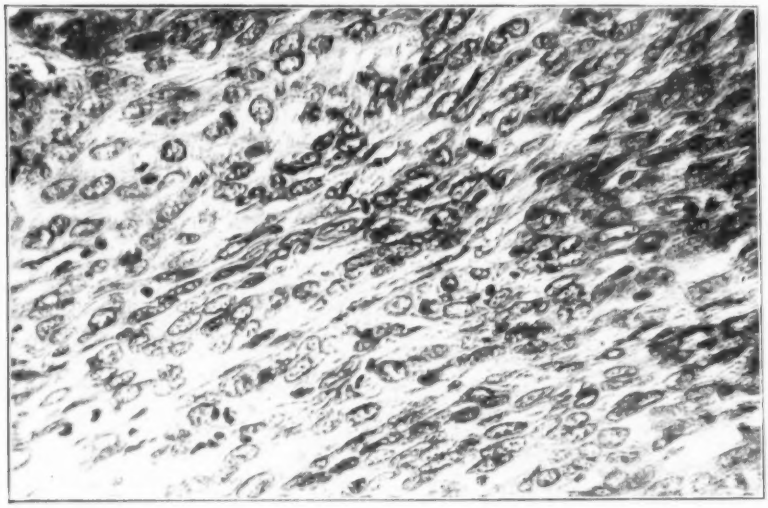

Fig. 2.—Fat spindle cell type, high power. The long and comparatively wide nuclei are characteristic.

Martzloff classified his cases according to their gross extent and the results of operative treatment and found that the spinal type grew the slowest and gave the best results. The order of malignancy of the others was the adenocarcinomas, transitional, and fat spindle, the last being the most malignant. Pomeroy and Strauss found that the spinal and adenocarcinomas gave the best results with radium treatment. Schmitz[4] also believes that the fat spindle type is the most malignant. Schmitz[5] finds that the different types respond to different doses of radium, that is the fat spindle requires the least for a destructive effect, the adenocarcinomas more and the spinal type the largest in the ratio of 100, 150, and 175. Dannreuther[6] believes that the fat spindle cell type is killed the easiest because sections of tissue removed after radium treatment show an absence of this type and

the presence of the spinal type, although both types were present before treatment. Adler[7] and Lahm[7] believe that the fat spindle cell type is the most resistant to treatment. Polak[8] states that the adeno-

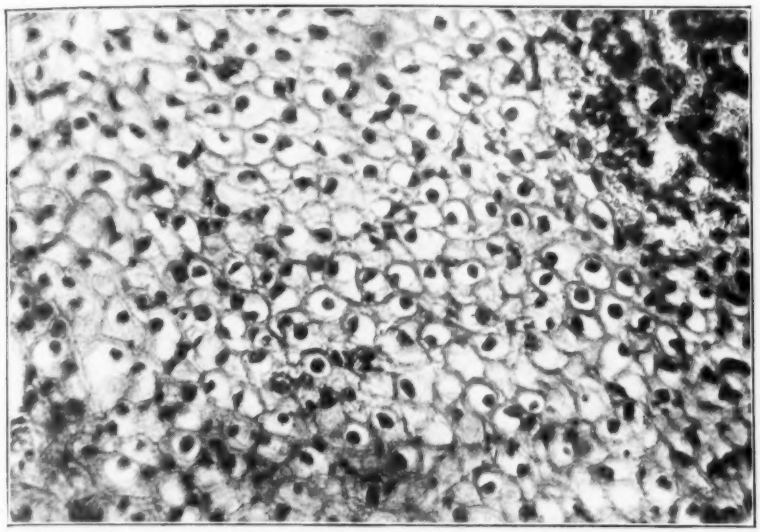

Fig. 3.—Spinal cell type, high power. The distinct cell membranes and polygonal shape are characteristic.

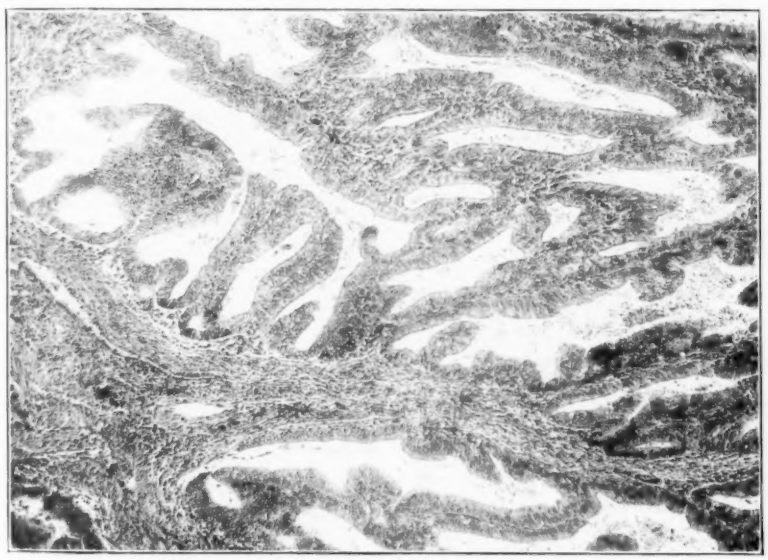

Fig. 4.—Adenocarcinoma, low power.

carcinomas are less susceptible to radium than the squamous. Klemperer[9] feels that the question of sensitiveness to radium is still undecided. Pomeroy and Strauss[3] find that although the transitional

type is destroyed more easily than the spinal, it appears to recur more rapidly.

We have already shown that most of the squamous carcinomas consist of all three cell types in varying proportion and it would therefore not seem reasonable to vary the dose of radium according to the predominating type. In the pure types this might be tried but if the largest dose is not going to be dangerous to life or health it would seem wiser to give it rather than to go by the histologic type because we are usually depending on a diagnosis from only a small part of the tumor. Dannreuther agrees that the radium treatment should not be varied according to the histologic type.

Klemperer[3] believes that the effect of radiation is determined not only by the tumor type but by its extent and the age and general condition of the patient, and by the amount of the dose of radium.

Schmitz[4] finds that the type of growth whether medullary, simplex, or scirrhous does not seem to influence the radiation sensitiveness of the cancer cells.

We have tabulated our cases according to whether the microscopic section showed the stroma amounting to more or less than 50 per cent of the tissue, giving the following figures:

A. Treated by radium.		
	Living	Dead
	Stroma more than 50%—3 cases	Stroma less than 50%— 1 case
	Stroma less than 50%—2 cases	
A. Treated by hysterectomy.		
	Living	Dead
	Stroma more than 50%—5 cases	Stroma more than 50%— 2 cases
	Stroma less than 50%—2 cases	Stroma less than 50%— 6 cases
C. Treated by radium.		
	Living	Dead
	Stroma more than 50%—1 case	Stroma more than 50%— 5 cases
		Stroma less than 50%—32 cases
D. Treated by radium.		Dead
		Stroma more than 50%— 3 cases
		Stroma less than 50%— 7 cases
C and D cases treated by operation alone.		
		Dead
		Stroma more than 50%— 3 cases
		Stroma less than 50%— 3 cases

The amount of stroma appears to make some difference in the results because of the preponderance of deaths among the cases with stroma amounting to less than 50 per cent despite the method of treatment.

Theoretically radium should be most effective in the scirrhous types of growth because part of its effect is obtained from the incarceration of tumor cells by dense connective tissue around them.

It seems only fair to say that of the 48 group C and D cases treated by radium alone all but five had a radium dosage of 2400 milligram hours or less at a treatment, and that 30 had two or more treatments. All cases that have had more than one treatment have died. We

believe that cases which have been treated since these with a larger initial dosage, up to 5400 milligram hours, are going to show better results but they are still too recent for any valuable conclusions to be drawn.

SUMMARY

The proportion between the three cell types in squamous cancer of the cervix is about the same in the different clinical stages of the disease.

The order of malignancy of the different cell types progressing from least to most is spinal, adenocarcinoma, transitional, and fat spindle.

The type of cell does not indicate whether operation or radium is the better treatment for any type.

The cases having more stroma than cancer tissue respond more favorably to either kind of treatment than where the conditions are reversed.

REFERENCES

(1) Urol. and Cutan. Rev., St. Louis, 1924, xxvii, 447. (2) Johns Hop. Hosp. Bull., 1923, xxxiv, 141. (3) Jour. Am. Med. Assn., 1924, lxxxiii, 1060. (4) Am. Jour. Obst. and Gynec., 1925, ix, 644. (5) Ibid., 1924, vii, 613. (6) Ibid., 1925, ix, 608. (7) Ibid., 1925, ix, 621. (8) Ibid., 1925, x, 140. (9) Ibid., 1925, ix, 621.

198 Commonwealth Avenue. (*For discussion see page* 607.)

THE CLINICAL SIGNIFICANCE OF X-RAY PELVIMETRY*

By Herbert Thoms, M.D., F.A.C.S., New Haven, Conn.
(From the Woman's Clinic, Yale University School of Medicine)

DURING the past five years, I have been interested in the determination, by means of the x-ray, of the lengths of the diameters of the pelvic inlet. The principles of the method which I have used were first described in a communication which was published in 1922.[1] Since that date, the technic has been simplified and improved, and in the present paper, I shall describe the procedure which is now employed.

The problems of this method of roentgen-ray pelvimetry are twofold. First, the position which must be maintained by the patient, in order to make the superior strait parallel with the sensitive plate; and secondly, the determination of the degree of divergence from the vertical which the x-rays undergo in their passage from the tube through the superior strait to the sensitive plate. A graphic representation of these problems is shown in Fig. 1, where *T* represents the tube or target, and *PSS* the superior strait, and *SP* the sensitive plate.

*Read, by invitation, at the Fifty-first Annual Meeting of the American Gynecological Society, Stockbridge, Mass., May 20, 21 and 22, 1926.

It is apparent, on viewing this diagram, that in order that the distortion thus produced may be equal in all directions, the tube must be centered over the superior strait and the plane of the superior strait must be parallel to the sensitive plate beneath.

These conditions are fulfilled when the patient is placed in the semirecumbent position, with the back arched, in the manner shown in Fig. 2. In order to determine the level of the superior strait, it is necessary to identify two points on the external surface of the body. These are located, one on the anterior surface of the symphysis,

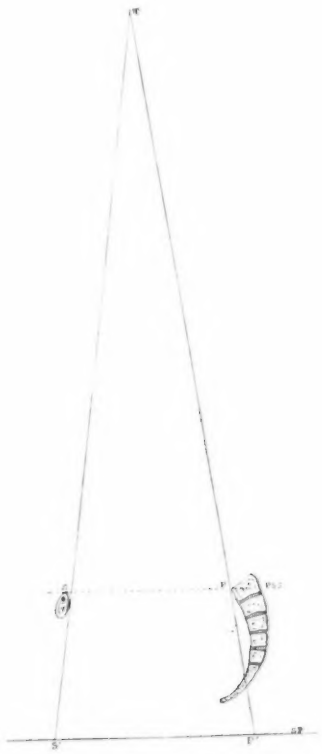

Fig. 1.—Showing direction of rays from target (*T*) through superior strait (*SP*) to sensitive plate. In order to have equal divergence the superior strait must be parallel to the sensitive plate (*S'P'*).

one cm. below the superior border, and posteriorly at the depression just below the spine of the fourth lumbar vertebra. An imaginary line connecting these two points traverses the anteroposterior diameter of the superior strait. It is essential, therefore, that these points shall be of equal distance from the plane upon which the patient sits.

The plane of the superior strait can be made parallel to the sensitive plate by employing the device shown in Fig. 3. With the horizontal arm placed on the upper anterior surface of the symphysis, the height is read from the vertical arm and an equal distance measured pos-

teriorly by means of calipers, as shown. The patient having been placed in this position, the tube is placed 36 inches above the plate, over a point 5 cm. posterior to the upper border of the symphysis

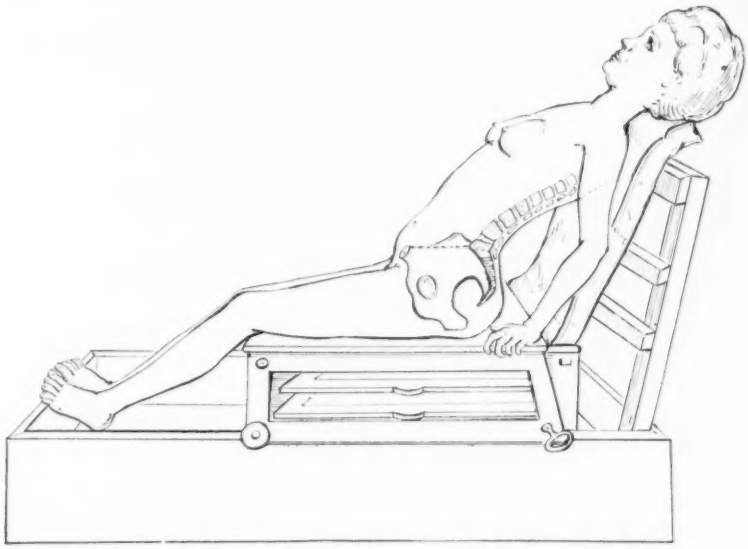

Fig. 2.—Patient in semirecumbent position with back arched. In this position the plane of the pelvic inlet is made horizontal and parallel to the sensitive plate beneath.

pubis. If the tube is centered in this manner, and the pelvis made horizontal, we have found that a moderate variation does not materially affect the end-result. Thus, the tube may vary 2 to 4 cm. away

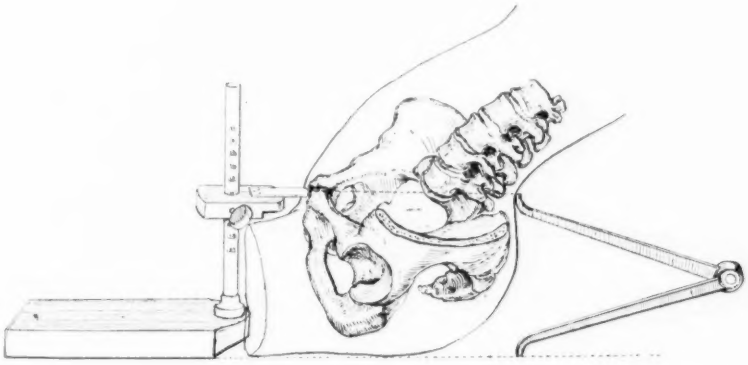

Fig. 3.—Showing method of making superior strait horizontal and parallel to sensitive plate beneath (see text).

from a point above the center of the superior strait, or the pelvis itself may vary 1 or 1.5 cm. from the absolute horizontal, without affecting the reading much more than a millimeter. This leeway makes the method one of practical application, because of personal

variations which are bound to occur, in placing and maintaining the correct position.

The second problem is the determination of the exact amount of divergence or spreading away from the vertical which the rays undergo in their passage from the tube to the plate. The character of the problem will be made clear by the study of Fig. 4. It is evident that in diagram A, in which the superior strait is represented as being 13 cm. above the plate, this divergence will not be as great as in diagram B, in which the superior strait is represented as being 18 cm. above the plate. It is also evident that the degree of distortion for different levels may be readily plotted upon a large piece of paper,

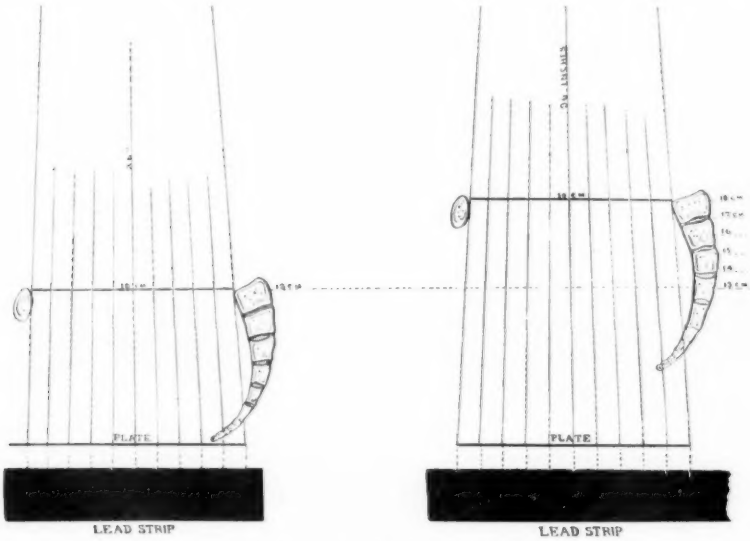

Fig. 4.—Diagrams explaining principle of this method of x-ray pelvimetry. Divergence of rays through the superior strait with the tube at 36" distance is measured and calibrated on lead strips (see text).

with the use of a *T* square and pencil. We determine, therefore, for all time, this divergence for planes from 11 to 22 cm. above the plate. The degree of divergence for each level is indicated by a series of notches upon a flat lead strip, and we then possess 11 lead strips notched as shown for the different levels described. It is apparent that these notches represent "corrected centimeters"—that is, each space between the notches represents a centimeter in the plane to be measured. The lead strip is placed upon the edge of the plate just before exposure. For example, if the patient's superior strait rests 16 cm. above the plate, number 16 strip is used. The amount of ray divergence at 36-inch tube distance is not as great as one might suppose; for instance, at a 19 cm. level, it is approximately as in the ratio of 10:12.5. That is, 10 cm. at the superior strait becomes 12.5 cm. on the plate.

The x-ray technic is as follows: Duplitized superspeed films, a double screen with Bucky diaphragm, and a medium focus Coolidge tube are used. The distance of the target plate is 36 inches. A point spark gap distance of 7 inches—which is equivalent to approximately 65 kilovolts—is employed. The amount of current is 20 milliamperes, and by using an ammeter in filament circuit, this voltage can readily be obtained without passing the current through the tube. A medium focus Coolidge tube will run easily up to approximately twenty seconds at this setting without greatly overheating. There is no apparent reason why with a heavy patient the tube may not be allowed to cool for ten or fifteen seconds, the patient holding the arched position, with possibly a second setting of the Bucky diaphragm. The time of exposure is as follows:

TIME

Pregnant		Non-pregnant	
Thin	16 seconds	Thin	10 seconds
Medium	20 seconds	Medium	14 seconds
Heavy	30 seconds	Heavy	17 seconds

As compared with other methods of roentgen-ray pelvimetry, the procedure which I have described is of unusual simplicity. Indeed, after a set of lead strips has been prepared, no further mathematical exercise is necessary, and the procedure occupies scarcely more time than does the taking of an ordinary roentgenogram. It is not necessary to emphasize its value in obstetrical practice. While the usual method of internal pelvimetry focuses attention almost entirely upon the measurement of the anteroposterior diameter of the superior strait, it is possible, by employing the procedure in question, to determine not only the length of this diameter, but also to measure the lengths of the transverse and oblique diameters with remarkable accuracy.

The practical value of such additional information is well illustrated in the accompanying pelvigram, in this case, that of a primiparous patient, the external diameters of whose pelvis were as follows: spines 22; crests 24.5; trochanters 29.25; external conjugate 16.75 cm. She was of short stature and weighed 94 pounds. We have repeatedly proved that in many individuals of this type, particularly those with a slight build, the capacity of the pelvis is surprisingly large, despite the fact that the lengths of the external diameters are far below normal. An examination of the pelvigram brings out this discrepancy—for in spite of the shortened external diameters, the anteroposterior diameter of the superior measures 10.75 cm., and the transverse diameter 12.25 cm.

At this point, I wish to refer to the taking of roentgenograms with the patient in the lateral position, an accessory measure which has been of great usefulness during the past year. This procedure, while not specifically employed as a means of pelvimetry, is of value in depicting the relationship of the fetal head to the superior strait, and is of importance in those cases in which an abnormality in the sacrum is suspected. The technic of the method is simple. With the patient

in the lateral position, the tube is centered over the crest of the ilium 36 inches above the plate, at a point midway between the symphysis and the depression underneath the fourth lumbar vertebra, and a suitable exposure made. The anterior and posterior surfaces of the sacrum in their lateral aspect are well shown and an outline of the fetal head, with its relationship to the superior strait, is readily distinguishable. When it is remembered that the unengaged head of the fetus usually rests with the occipitofrontal diameter parallel to the transverse diameter of the inlet, it is apparent that an estimation of the length of the biparietal diameter can also be made (see Fig. 6).

In the use, therefore, of the two methods above described, we feel that we possess substantial additions to our usual pelvimetric pro-

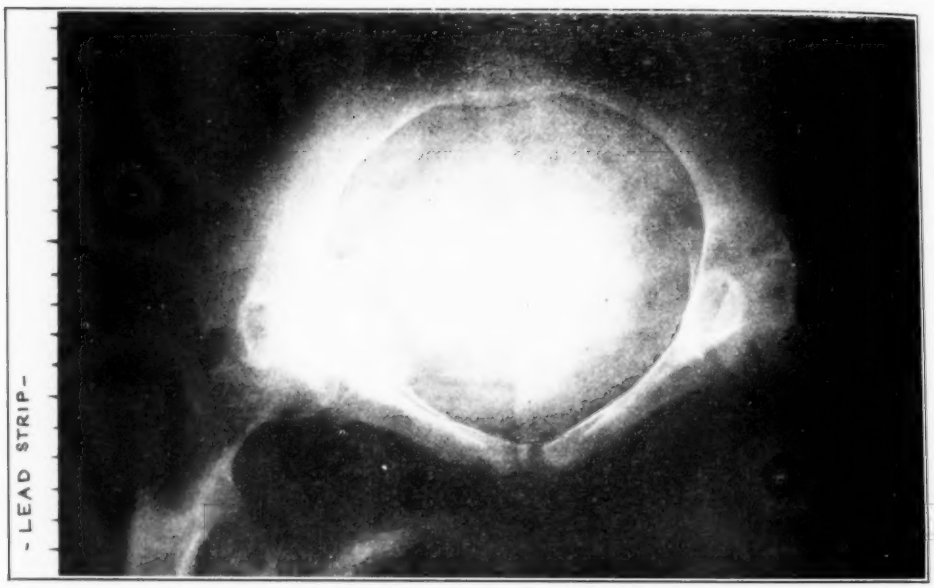

Fig. 5.—Pelvigram showing outline of superior strait. Scale at side of film in "corrected centimeters." By means of calipers any diameter of this plane may be measured readily.

cedures. Their application is much more difficult to describe than to perform. It is unusual for us, in performing both technics, to occupy more than ten minutes with each patient. Their clinical application is obvious. It is our custom to take pictures of the inlet in all patients in whom the external measurements point to pelvic abnormality. Where the influence of rickets is suspected, we have found at times that the only definite means of diagnosis depends upon the roentgenographic study of the sacrum. The routine use of this procedure in abnormal pelves I feel certain is going to point out a greater incidence of rachitic deformities than we have hitherto supposed, particularly in the milder grades. In patients in whom the fetal head fails

to become fixed at the superior strait at term, we can readily determine whether the nonengagement is the result of bony disproportion or is due to some other factor. In a recent patient, in whom the fetal head was floating at term, a lateral picture showed the presenting part high above the superior strait, in spite of the fact that a space 2-3 cm. in width was present between the posterior parietal bone and the promontory of the sacrum. Although measurements of the diameters of the inlet showed the pelvis to be of adequate dimensions for a moderate sized fetus, manual pressure from above failed to force the occiput into the superior strait. It was evident that some other than

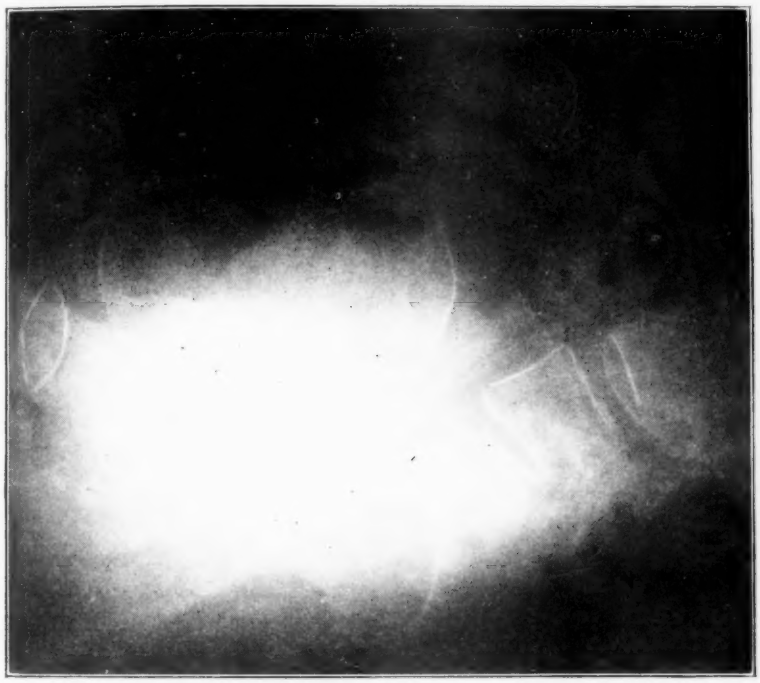

Fig. 6.—Lateral roentgenogram at term. Showing relationship of presenting part to superior strait where disproportion was suspected because of nondescent. No disproportion present, sacrum shows normal concavity of anterior surface.

bony disproportion on the part of the mother was present. Because the previous labor had been terminated by cesarean section, it seemed wise, under the circumstances, to effect delivery in a similar fashion. Following the removal of the fetus, the placental site was found low down on the posterior wall of the uterus, and it appears that the undescent of the fetal head in this patient depended upon interference offered by an unusually low implantation of that organ.

SUMMARY

1. A method of x-ray pelvimetry has been presented by means of which the dimensions of the superior strait can be measured with re-

markable accuracy. The method is applicable in any stage of pregnancy and does not require elaborate apparatus.

2. A technic has been described which makes it possible to obtain lateral views of the pelvis showing the contour of the sacrum and the relation of the presenting part to the superior strait. Attention is drawn to the value of such information in the diagnosis of the less severe grades of rachitic pelvic deformity.

3. The importance of the two methods as aids in the study of contractions of the pelvis is emphasized.

In conclusion, I wish to acknowledge my indebtedness to Dr. C. R. Scott and Mr. E. F. Furbush, of the Department of Roentgenology of the New Haven Hospital. Their help in working out the technic of taking the pictures has been invaluable.

129 WHITNEY AVENUE. (*For discussion see page 599.*)

TRIAL LABOR IN THE TREATMENT OF 477 CASES OF CONTRACTED PELVES*

CONDUCTED UNDER ONE PLAN OF TREATMENT DURING THE LAST FOUR YEARS

BY HAROLD BAILEY, M.D., NEW YORK, N. Y.

OBSTETRICS is, for the most part, in the hands of the general practitioner, and as perfect surgical technic is not readily acquired by the occasional operator, the existing high maternal death rate is without doubt related to his errors. These have become more pronounced in the last few years, for conservatism has been abandoned and we are in an era of operative obstetrics. This is due to the attitude of the leaders in the medical centers. Because of the high infant mortality, the time honored resources of induction, high forceps, version and craniotomy are frowned upon in the management of labor in contracted pelves. When disproportion is present or the pelvic measurements are below normal, it is impossible to judge whether or not a spontaneous delivery can occur, and if in a test of labor the head fails to engage, the accoucheur has now but one procedure at his command. He must do a cesarean section or send the patient to a hospital where, frequently, a man unversed in obstetrical mechanism opens the uterus forthwith. The incidence of cesarean section has increased until in certain clinics it is as high as 7.1 per cent.[1]

The question to be considered is whether the adoption of cesarean section has resulted in an increased saving of life of mother and child. In New York State (outside of New York City) one out of

*Read at the Fifty-first Annual Meeting of the American Gynecological Society, Stockbridge, Mass., May 20, 21 and 22, 1926.

every five maternal deaths follows cesarean section. In the year 1922, 127 women died following this operation. In 79 of the cases, concerning which questionnaires were answered by the doctor, 25, or nearly one-third of the babies were stillborn.[2] In Massachusetts, in the same year, 102 women died following cesarean section; 37 per cent of these operations were for pelvic contraction. The death rate was one in every seven maternal deaths and the fatality for the operation was 8.8 per cent. Of these 102 dead mothers only 67 per cent of the babies survived, and it is quite evident that in this particular group, recourse to high forceps and craniotomy, where necessary, would hardly have produced such a high infant death rate.[3] The results of a questionnaire sent to hospitals in Michigan showed that the maternal death rate (in the 192 answers, 1914-1920) was 10.9 per cent and the infant death rate 13.5 per cent.[4] Nothing could be more startling than the report from New Orleans. In 117 abdominal sections in one hospital there were 12 deaths from peritonitis, 2 from sepsis and 2 other deaths from the operation. In addition there were 25 deaths due to the disease for which the cesarean was performed and the total death rate following cesarean section was 35 per cent.[5] These figures are amazing and show how far the pendulum has swung.

No one would advise the readoption of induction of labor as a general treatment for cases of contracted pelves yet there are figures that prove it to be much less detrimental to mother and child than cesarean section.*

In the latter part of 1921 we became convinced that the Kroenig, Beck, DeLee transperitoneal, low flap cervical cesarean section gave better results, late in labor, than the classical operation. Beck's paper[6] and later, DeLee's,[7] fortified us in this conclusion. Previous to 1922 the published figures did not justify us in conducting trial labors. In 1920, Campbell[8] reported 92 cases operated late in labor with a fatality of 15.5 per cent. We had, also, the report of the English cases in which the mortality, after cesarean section performed late in labor, was 10.7 per cent.[9] The introduction of the low flap cervical cesarean enabled us to conduct trial labor. Hofbauer[10] has recently demonstrated evidences of increased resistance to infection in the lower uterine segment.

Trial Labor.—All pelves with a true conjugate below 7 cm. are absolutely contracted and should be delivered by elective sections. It is interesting to note that during the last four years we had only two cases of absolute contraction. In generally contracted pelves with breech presentation elective sections were done except in the cases noted below. All patients with relatively contracted pelves,

*From 1912 to 1920, at which date the operation was given up at the Manhattan Maternity Hospital in New York, there were 44 inductions for contracted pelves with no maternal deaths and 10 per cent infant deaths.

with the exception of those who had been previously cesareanized, were given a trial labor. The trial labor was conducted by allowing the patient to have twelve hours of strong pains and without vaginal or rectal examinations. If at the end of this time, the head was floating, a low flap section was performed. If the head was in the pelvis the patient was delivered either by permitting the labor to continue or by forceps. As many of our patients were ambulance cases and nearly one-half of the total number were delivered on our outdoor services, this regimé could not be strictly adhered to and we regret that a few patients had a prolonged labor. In some cases where there was doubt as to whether or not the head had entered the pelvis, vaginal examinations were made.

There is some danger in permitting too long a trial labor. If the patient goes into secondary inertia she almost invariably suffers from an acidosis and may even lose her life from this condition.

Classification.—We have reduced the generally accepted measurements of pelvic contraction by deducting one-half centimeter from the diagonal conjugate so that our classification includes no pelvic inlet with a diagonal conjugate of more than 11 cm. for the generally contracted and 10.5 cm. for the flat type. These figures have been selected for two reasons. In the first place, all of our patients with higher measurements were delivered spontaneously or with low forceps, and in the second place, the average reach of the examining finger is seldom over 11 cm. Many women have a diagonal conjugate measurement just above 11 cm. and designating such pelves as contracted magnifies the incidence and importance of the condition. Furthermore, we have deducted 1.5 cm. from the diagonal conjugate to determine the true conjugate because 1.5 cm. is in accordance with the measurements as we have determined them on dry specimens and also because this distance is variable, depending upon the movement of the lower part of the body on the sacrum.

In determining the outlet contractions we have deducted one centimeter from the usual measurements, and we consider a funnel pelvis one with a transverse of 7 cm. or under. We have noted, in private practice, that a large proportion of women have a transverse measurement of 8 cm. and that these patients deliver spontaneously, without prolongation of labor or increase in the lacerations.

The regular reduction in the interspinal, intercristal and oblique measurements in the generally contracted pelves enabled us to differentiate them from the flat. It is of great importance to distinguish between these types because the mechanism of labor differs. The external conjugate measurement was of little value in estimating either the degree of contraction or the possibility of a spontaneous delivery. We were able, also, to determine the types of pelves by the changes in form of the Michaelis' rhomboid.

In a certain number of cases the internal measurements were not obtained until late in the postpartum period as we wished to avoid vaginal examinations in order to limit the chances of infection. With this limitation of infection in mind, we have developed our technic of external examination and mensuration to a degree whereby we can usually conduct labor to its outcome without vaginal or rectal examinations.

TABLE I

ESTIMATED TRUE CONJUGATE MEASUREMENTS IN 221 GENERALLY CONTRACTED AND 218 FLAT PELVES OCCURRING IN 9087 DELIVERIES AT BELLEVUE HOSPITAL AND THE BERWIND CLINIC, 1922-1925

ESTIMATED TRUE CONJUGATE	METHOD OF DELIVERY									
	SPONTANEOUS		CESAREANS		FORCEPS		VERSIONS		CRANIOTOMIES	
	G. C.	Flat	G. C.	Flat	G. C.	Flat	G. C.	Flat	G. C.	Flat
6.5	0	0	0	2	0	0	0	0	0	0
7.0	0	1	1	0	0	0	0	0	0	0
7.5	1	4	3	2	0	0	0	0	0	0
8.0	9	9	5	7	0	2	0	0	1	1
8.5	52	73	8	10	8	25	2	5	1	0
9.0	45	57	3	4	8	8	2	2	0	0
9.5	61	0	4	0	4	0	0	0	0	0

Accepting the fact that a pelvis is rachitic when the interspinal and intercristal measurements are nearly equal and the outlet is wide, there were only 18 cases that gave unmistakable evidence of the disease either through pelvic or general examination. Two cases had the same interspinal and intercristal measurements and in 16 these measurements were within 1.5 cm. of each other.

We have classified all pelves as generally contracted, flat, funnel or irregularly contracted, and under these classifications there were, in a total of 9087 cases, 221 generally contracted, 218 flat, 35 funnel and 3 irregularly contracted pelves.

Generally Contracted Pelves.—

Major Contractions: true conjugate 8.5 – 7.5 cm.
Minor Contractions: true conjugate 9.5 – 8.6 cm.

Two hundred and twenty-one or 2.4 per cent of all the deliveries were in women with generally contracted pelves. The average measurement for the crests was 24.4 cm.; in only 5 cases was it as high as 26. Twenty-three per cent of the deliveries were operative.

Ten of the 221 women had had previous sections, and therefore, as a matter of course, an elective cesarean was performed as soon as they were received in the hospital. Another of the patients had an elective cesarean for chronic heart disease.

There was a trial labor in the remaining 210 cases. Sixteen cesarean sections were performed. In one case the wound broke down and in four there were stitch abscesses. Eight of the women, including those with infected wounds, had a temperature for two days or

TABLE II

AVERAGE PELVIC MEASUREMENTS IN 221 GENERALLY CONTRACTED PELVES

METHOD OF DELIVERY		NUMBER OF CASES	SPINES	CRESTS	EXTERNAL CONJUGATE	RIGHT OBLIQUE	LEFT OBLIQUE	DIAGONAL CONJUGATE	TRUE CONJUGATE
Spontaneous	Major	54	21.2	24.3	18.0	20.3	20.0	9.7	8.2
	Minor	114	21.4	24.2	18.5	20.6	20.6	10.7	9.2
Cesareans	Major	16	21.6	23.7	17.3	19.8	19.9	9.5	8.0
	Minor	11	21.5	23.7	18.0	20.5	20.1	10.6	9.1
High Forceps	Major	3	21.0	24.3	17.0	19.7	19.7	10.0	8.5
	Minor	3	22.0	25.0	17.7	20.0	20.7	10.3	8.8
Mid and Low Forceps	Major	4	21.5	25.2	17.2	20.5	20.5	9.8	8.3
	Minor	9	22.5	25.0	17.2	20.2	20.1	10.5	9.0
Versions	Major	2	21.0	24.0	19.0	21.0	20.0	10.0	8.5
	Minor	3	21.3	25.0	18.0	20.7	20.5	10.5	9.0
Craniotomy	Major	2						9.8	8.3
	Minor	0							

more. Vaginal examinations were made in 7 cases, three of them followed by temperature. There were no maternal deaths in these 16 cases. The average weight of the infants was 3098 grams. The average number of hours of labor was twenty-three, or deducting a long labor at home in two cases, the average was seventeen hours.

High forceps operations were employed in 6 cases in which the head had entered the pelvis during the trial labor. There were no maternal deaths and but one infant death.

There were 13 mid and low forceps deliveries with 3 infant deaths. One mother died of sepsis on the eighteenth day postpartum.

Five versions and breech extractions were performed with the loss of one infant,—a baby that died in utero from premature separation of the placenta. We wish to state definitely that we do not believe in permitting a patient with a breech presentation in a generally contracted pelvis, to have a trial labor, and we do not believe in versions in this type of pelvis, but in the delivery of so many cases, variations from a standard routine are almost unavoidable.

There were 2 craniotomies. One patient was admitted after a long labor with an attempt at forceps delivery at home. A version and extraction was performed, but as the child was dead, the after-coming head was punctured. The other was admitted with a shoulder presentation and a prolapsed arm. As the baby was dead the delivery was by version and craniotomy.

In the 221 cases there were 13 stillbirths and neonatal deaths; six of these followed spontaneous deliveries.

There were three maternal deaths; one woman with a major and two with minor contractions. One woman was delivered spontaneously on our outdoor service, and because of hemorrhage the placenta was manually removed. Sepsis followed and the patient died on the sixteenth day. The second woman was delivered by a mid-forceps operation for an occiput posterior position; the operation was not difficult. She had a form of postpartum sepsis that resembled scarlet fever, and on the eighteenth day, three days after her temperature was normal, she died suddenly of a septic embolus in the brain. The autopsy showed pyelitis of both kidneys, and in the brain there was considerable degeneration around the thrombosed area. The third patient, after thirty hours of labor on our outdoor service was transferred to another hospital. Four hours after her admission she was prepared for cesarean section, and shortly after the anesthesia was started, she suddenly died. The autopsy was negative but as we believe that death might have been due to acidotic shock following a long labor, we have included this case with our maternal deaths. These three were the only deaths that occurred in the 477 cases and one of these women died from a cause unrelated to the pelvic contraction.

TABLE III

AVERAGE PELVIC MEASUREMENTS IN 218 FLAT PELVES

METHOD OF DELIVERY		NUMBER OF CASES	SPINES	CRESTS	EXTERNAL CONJUGATE	RIGHT OBLIQUE	LEFT OBLIQUE	DIAGONAL CONJUGATE	TRUE CONJUGATE
Spontaneous	Major	14	24.2	27.2	19.5	21.9	21.9	9.3	7.8
	Minor	131	23.9	27.1	19.1	21.5	21.5	10.2	8.7
Cesareans	Major	11	24.6	27.5	18.4	21.8	21.7	9.2	7.7
	Minor	16	23.6	27.2	19.1	21.3	21.4	10.0	8.5
High Forceps	Major	0							
	Minor	11	23.5	26.6	18.8	20.9	20.8	10.1	8.6
Mid and Low Forceps	Major	1	25.0	26.0	18.0	22.0	23.0	9.5	8.0
	Minor	26	23.7	27.1	19.4	21.5	21.7	10.2	8.7
Versions	Major	0							
	Minor	7	23.4	26.9	19.4	19.8	19.7	10.1	8.6
Craniotomy	Major	1	23.0	27.0	21.0	23.0	23.0	9.5	8.0
	Minor	0							

Flat Pelves.—

Major Contractions: true conjugate 8 – 7 cm.
Minor Contractions: true conjugate 9 – 8.1 cm.

It was an unexpected finding that the flat pelves nearly equalled in number the generally contracted. Furthermore, it so happened that there were 27 cesarean sections.

Ten sections were elective: 7 because of previous cesareans, one because a patient with a major contraction had had stillbirths in three previous deliveries, and 2 for prolapsed cords. There were 2 infant deaths.

In the 208 cases that had a trial labor, 17 cesareans were necessary. The wound broke down in one case and there were stitch abscesses in two. There was a temperature for two days or more in 10 cases, including those with the wound infections. In four cases vaginal examinations were made without any morbidity in the postpartum period. The average number of hours of labor in these 17 cases was twenty-six and eight-tenths, including 5 cases transferred from the outside with an average of forty-three hours. The average weight of the babies was 3337 grams. It is interesting that the average weight of the children in the flat pelves is only 239 grams higher than that of the infants in the generally contracted pelves.

There were 38 forceps deliveries of which 11 were high forceps. Two stillbirths occurred with the high forceps deliveries, one in a case with prolapsed cord. In the 27 mid and low forceps, there was one stillbirth—an infant with hydrocephalus.

Seven versions and breech extractions were performed. One stillbirth occurred in a case of prolapsed cord. One patient who had had a cesarean section at a previous delivery was delivered from below because, when admitted, she had influenza and was fully dilated, with the breech presenting. Two other cases of breech presentation were allowed to have a trial labor and were then delivered by breech extraction.

There was one craniotomy. The patient had been in labor forty-two hours at home, under the care of a private doctor, and as many vaginal examinations had been made, it was felt that a cesarean was inadvisable. The extraction following a version was difficult, and the craniotomy was done on the after-coming head.

In the 218 cases of flat pelves, 73 (or 33 per cent) were operative deliveries. There was a total of 12 infant deaths, 5 of them occurring in spontaneous deliveries.

Funnel Pelves.—

Major Contractions: transverse 6 – 5 cm.
Minor Contractions: transverse 7 – 6.1 cm.

Eleven of the 35 cases in this group were operative: 3 cesareans, 7 forceps, and one version. There were one stillbirth and one neonatal

death in the spontaneous deliveries and one neonatal death followed the version.

One of the three cesareans was for a major outlet contraction in a pelvis that was also somewhat flattened, and two were for minor contractions in pelves that were also generally contracted. In the three cases the head was floating after hours of labor. These cases have been included in the funnel class because the narrow transverse was the distinguishing feature of the pelves. The two generally contracted were of the male type.

TABLE IV

TRANSVERSE OF THE OUTLET MEASUREMENTS IN 35 FUNNEL PELVES

TRANSVERSE OF THE OUTLET	TOTAL NUMBER OF CASES	METHOD OF DELIVERY				
		SPONTANEOUS	CESAREAN	HIGH FORCEPS	MID FORCEPS	VERSION
5.5	1	0	1	0	0	0
6.0	2	1	0	0	1	0
6.5	5	2	2	0	0	1
7.0	27	21	0	2	4	0
	35	24	3	2	5	1

Seven forceps deliveries were necessary, 6 in pelves with a transverse of 7 cm. and one high forceps in a pelvis with a transverse of 6 cm. There were no infant deaths.

In addition, 12 contracted outlets of the minor variety were found in pelves that were generally contracted or flat, and in these cases there were 5 cesareans and 3 forceps deliveries. I believe that in considering the funnel pelves these 12 cases should be added, thus giving a total of 47 funnel pelves or approximately 10 per cent of all the cases. Nineteen or 40 per cent of the 47 funnel pelves required operative delivery. There were no maternal deaths and 6.3 per cent infant deaths.

Irregular Contractions.—There were 3 irregularly contracted pelves. One was a case of infantile paralysis with scoliosis; the second, marked scoliosis of the thoracic and lumbar spine; the third, ankylosis of the hip with flattening of the side wall of the pelvis.

Two of the cases required cesarean sections and the third a mid forceps operation. One baby delivered by cesarean died in the neonatal period.

Discussion.—If we accept this report as indicating a satisfactory result with trial labor in contracted pelves, it seems to me that the ordinary accoucheur would find it advisable to employ this form of treatment in all relatively contracted pelves. He would have (at least in the region around New York where there is little rachitis) an incidence of less than 6 per cent of contracted pelves that required treatment as such. While, according to our figures, 30 per cent would prove to be operative, only 16 per cent would demand cesarean or

high forceps operations. The incidence of the cases that must be transferred for major operations would be nine-tenths of one per cent. It seems probable that if the occasional operator knew that the more serious type of case is less than one in a hundred, he would be willing to refer such cases to a suitable hospital where a low flap, cervical cesarean section could be performed.

TABLE V

477 CASES OF CONTRACTED PELVES IN 9087 DELIVERIES

	TOTAL NUMBER OF CASES	TOTAL SPONTANEOUS DELIVERIES	OPERATIVE DELIVERIES					
			TOTAL	CESAREAN	HIGH FORCEPS	MID FORCEPS	VERSION	CRANIOTOMY
Generally Contracted	221	168	53	27	6	13	5	2
Flat	218	145	73	27	11	27	7	1
Funnel	35	24	11	3	2	5	1	0
Irregular	3	0	3	2	0	1	0	0
	477	337	140	59	19	46	13	3

Net Maternal Death Rate—0.42 per cent.
Net Infant Death Rate—4.19 per cent.

In the spontaneous deliveries, labor was not longer than in the spontaneous deliveries in normal pelves; as a matter of fact, the average hours of labor in both the generally contracted and the flat types was less than normal. The mechanism of labor in the generally contracted pelvis is more perfect than in the normal because there is complete flexion of the child's head. In the flat pelvis the head often hangs up at the brim and passes through in an asynclitic position, and there is an anterior or posterior parietal bone presentation. We have not used the Barton forceps for the control of this, as we believe that it is Nature's attempt to compensate for the disproportion. Occasionally in the anterior parietal bone presentation we have pushed the occiput to the rear at the same time that the external hand pushes over the child's shoulder. At a certain point in the progress of the child's head through the contracted inlet this is readily done and labor comes to a close without more difficulty.

In the 145 spontaneous deliveries in generally contracted pelves, 118 women had a labor of twelve hours or less, and 8 had a labor of more than twenty-four hours. There were 146 cases of spontaneous delivery in flat pelves in which a complete record of the hours of labor was kept. One hundred and ten patients had twelve hours or less of labor, and only 12 had more than twenty-four hours.

Our statistics show that the generally contracted and flat pelves are nearly equal in number and that few of the deformities are due to rickets. Seventy-five per cent of these pelves had a true conjugate of 8.5 or 9 cm.; there were only two with a true conjugate of 7 cm. and two with 6 cm. Seventeen of the cases that we included in the generally contracted classification, were both generally contracted and

flat. As is well known, a decrease in the anterior posterior diameter in a small pelvis markedly increases the necessity for operation and in these 17 cases there were 9 cesareans. The other 8 cases delivered spontaneously with an average of nine hours of labor.

TABLE VI

AVERAGE PELVIC MEASUREMENTS IN 220 GENERALLY CONTRACTED* AND 218 FLAT PELVES

MEASUREMENTS	220 GENERALLY CONTRACTED			
	SPONTANEOUS 168	OPERATIVE 53	SPONTANEOUS 145	OPERATIVE 73
Spines	21.3	21.5	24.1	24.0
Crests	24.3	24.5	27.1	26.9
Ext. Conjugate	18.3	17.7	19.3	18.8
Right Oblique	20.5	20.3	21.7	21.2
Left Oblique	20.3	20.2	21.7	21.4
Diagonal Conj.	10.2	10.3	9.7	9.8
True Conjugate	8.7	8.8	8.2	8.3

*Measurements not complete in 1 generally contracted pelvis.

Four prolapsed cords occurred in the course of the trial labor in the 210 flat pelves. Two babies survived, both delivered by cesarean section. On opening the uterus the cord was tied off from the baby and from the placenta and delivered from below.

The number of abnormal positions in all cases of contraction was not greater than is usual in normal pelves. There were four face, three shoulder and thirteen breech presentations.

We had a low incidence of funnel pelves of the male type, that is, of those with little disproportion except at the outlet. Only one patient had a transverse measurement of the outlet of 5.5 cm., and she was delivered by cesarean section.

TABLE VII

29 STILLBIRTHS AND NEONATAL DEATHS IN 477 CASES OF PELVIC CONTRACTION

METHOD OF DELIVERY	GENERALLY CONT'D		FLAT		FUNNEL		IRREGULAR	
	STILL-BIRTHS	NEO-NATAL DEATHS	STILL-BIRTHS	NEO-NATAL DEATHS	STILL-BIRTHS	NEO-NATAL DEATHS	STILL-BIRTHS	NEO-NATAL DEATHS
Spontaneous	2	4	3	2	1	1	0	0
Cesareans	0	0	1	1	0	0	0	1
High Forceps	1	0	2	0	0	0	0	0
Mid Forceps	2	1	1	0	0	0	0	0
Version	1	0	1	0	0	1	0	0
Craniotomy	2	0	1	0	0	0	0	0
	8	5	9	3	1	2	0	1

Gross Infant Mortality—6.08 per cent.
Net Infant Mortality—4.19 per cent.

SUMMARY

The Cornell teaching service, during the years 1922 through 1925, delivered 9087 women on three services—Bellevue Hospital and the Bellevue School for Midwives during six months of each year and the

Berwind Maternity Clinic during twelve months. There were 477 cases of contracted pelves or 5.2 per cent. As far as possible the treatment of the patients was by trial labor, and in my opinion, the success of the procedure depended upon the fact that the low flap cervical section was done in cases in which the head did not engage. There were 59 cesareans with no maternal deaths and 3 infant deaths. In the 22 elective sections, there were 14 low flap operations. Four patients had postoperative temperature. The wound was infected in 3 cases. Vaginal examinations were made in 2 cases but with no morbidity in the postpartum period.

Thirty-seven patients had a section following trial labor and of these 35 were operated by the low flap method. In the group there were 11 cases that had been examined vaginally. The study of the convalescence shows that 21 of the patients had a temperature of 100.4 degrees or higher for two days or more, 4 had a temperature for two days, 12 for less than five days, 1 for six days and 4 for eight days. The wound healed by primary union in 28 cases with postoperative temperature; in 2 cases it broke down, and in 7 cases there were stitch abscesses. Only one of the patients had a serious postpartum condition; in most of the others the fever occurred in the first few days following operation. We feel that the protection of the incision will eliminate some of the infections, as it is probable that these occur when the child and the membranes are brought through the wound. The postoperative period was peculiarly free of the complications that usually follow the classical section.

As an end-result of trial labor, in the 477 cases, there was a gross mortality of three mothers, two dying of sepsis and one from anesthesia in a hospital not under our control. If we except the patient with sepsis following spontaneous delivery, there was a net mortality of two, or one in 238 cases. There was a gross mortality of 29 babies or a net mortality of 20. We had, then a maternal death rate of .42 per cent and an infant death rate of 4.19 per cent.

Trial labor in relatively contracted pelves reduces the incidence of operation and results in a minimum mortality for mother and child provided that when a cesarean is necessary the low flap cervical section is employed.

REFERENCES

[1]Potter, I. W.: Am. Jour. Obst. and Gynec., 1921, i, 560.
[2]New York State Department of Health; Personal Communication, March 30, 1925.
[3]Hamblen, A. D.: The Commonwealth (Boston), 1923, x.
[4]Campbell, A. M.: Jour. Mich. State Med. Soc., December, 1920.
[5]King, E. L.: Jour. Am. Med. Assn., July 8, 1922.
[6]Beck, A. C.: Am. Jour. Obst. and Gynec., 1921, i, 586.
[7]DeLee, J. B.: Jour. Am. Med. Assn., March 14, 1925.
[8]Campbell, A. M.: Jour. Mich. State Med. Soc., December, 1920.
[9]British Med. Jour., Oct. 21, 1921.
[10]Hofbauer, J.: Bull. Johns Hopkins Hosp., April, 1926, xxxviii, 255-272.

(*For discussion see page* 594.)

LIGATION OF PELVIC VEINS IN THROMBOPHLEBITIS*

By R. R. Huggins, M.D., Pittsburgh, Pa.

IN THE year 1912, the writer reported four cases where ligation of veins had been done in the treatment of puerperal thrombophlebitis. The history of this operation was also reviewed. It is not our purpose to waste time in the study of the past, so far as the history of this procedure is concerned. It does seem worth while, however, to report our results from time to time in order that some definite conclusion may finally be reached as to the value of this method in the treatment of this form of puerperal infection. The pathology is so well understood that it need not be discussed. Little has been written upon this particular line of treatment since that time. The available number of cases for study at the time of this report was 110. Sanes in a report some months later found 12 additional cases which made in all 122. The mortality was 52.5 per cent. It is quite apparent from a study of this small series of cases that operation was not performed in a majority of instances, until the patient was profoundly ill. Turenne in 1917, reported 17 cases, which included 4 operated upon by the writer, with a mortality of 29.4 per cent.

The operative treatment has at least accomplished one thing, and that is a better knowledge of the diagnosis and pathology of this form of infection. The few reports which appear, indicate that the symptoms which are characteristic of this particular form of infection are now generally recognized. This is a distinct advance, for if operative treatment is ever to be employed it is only after most careful study and observation. Mild cases are constantly observed where no thought of operative treatment should be entertained. On the other hand a patient is occasionally encountered where the symptoms are severe, and where in spite of all palliative measures, the disease grows progressively worse and the patient finally dies.

It remains to be decided whether in such a case, operative treatment is worth while. Those who have had the largest experience in the exploration and ligation of the invaded vessels are more inclined to favor it than those who have had little experience. The reason is, because they have learned that an operation undertaken early before the patient has lost much of her resistance, does little if any harm. We have never seen the chances of a recovery lessened as a result of exploration of the abdomen. It is idle to expect good results if the

*Presented at the Fifty-first Annual Meeting of the American Gynecological Society, Stockbridge, Mass., May 20, 21 and 22, 1926.

operation is postponed until the patient is moribund. For this reason correct diagnosis at the proper time is most necessary.

According to our present knowledge this variety of infection should be recognized from the study of the clinical chart. The wide range of temperature, which may vary from below normal to 104 or 105, in the form of daily excursions; the pulse corresponding to the rise and fall of temperature; the presence of chills, especially during the early stages; a patient who in the first few days of her illness does not present the appearance of one acutely ill; the absence of positive blood cultures under ordinary methods. These are all signs which are most suggestive, and as a rule, are diagnostic of this particular form of infection. When local examination reveals only the presence of moderate enlargement on either side of the uterus and possibly only tenderness, strong corroboration is added. We recognize, of course, the acute fulminating variety where the disease is more virulent and where the patient dies in a very short time. In such cases the progress is so rapid that the patient dies within a few days. In such a condition, operation is useless, for as a rule, there is a rapid spread of the infection through the blood stream which is soon overwhelming. From the beginning the outlook is grave. The case where the operation is of value is one which lies between the above-mentioned milder forms, where the temperature and pulse variations are not so wide, and where the patient from the beginning does not show evidence of very serious involvement, and the acute fulminating variety where the progress is rapid and grave from the beginning. Here we find a group of cases which are prone to become chronic and where in about eight or ten days after the onset of the infection, one is gravely perplexed as to what may happen from day to day. Such a case may eventually entirely recover under palliative treatment; on the other hand, she may drift on from day to day, at times showing marked improvement which leads the obstetrician to be encouraged, but finally dies. It is at this particular time, early in the history of such a case, and before the patient has become repeatedly saturated with the infection, and where a certain amount of poison is being thrown into the circulation daily, with a resulting lowering in her resistance, that a definite conclusion as to the indication for operative treatment should be made. It is fortunate, that in the majority of instances, the progress is rather slow and for the first ten or twelve days the patient may not be in any immediate danger.

Our experience leads us to conclude that there is little difficulty in coming to a determination, both as to a probable diagnosis and to the time when the patient is entitled to an exploration of the abdominal cavity. Our records show that nearly all cases of this class which are operated upon within twelve or fifteen days after the onset of the infection, recovered. The mortality lay in those who had been ill for

more than four weeks. In three fatal cases, more than six weeks had passed before operation was even considered. Infection had already extended far beyond the veins in the form of multiple abscesses or so-called pyemia. Operation at such a time is a useless expenditure of energy, just as it often is in the later stage of a peritonitis which has followed a perforation of an appendix or gastric ulcer. In a general way, if a patient has a chill for three or more successive days, accompanied by the typical rise and fall of temperature and the blood cultures as done by the ordinary method are negative, and where no signs of improvement appear, she is entitled to the help which may be received through surgical measures. It is our belief when operation is done in this stage of the disease, that it does not jeopardize the life of the patient. Even in cases where recovery does not occur, the patient's chances are in no way lessened, as they continue to live long after the time of operation, and eventually die from the continued extension of the infection.

During the earlier years in the history of the operative method of treatment, there was considerable discussion as to the method of procedure. At first it was proposed that the veins be approached from behind and that the operation should be retroperitoneal. This method was followed on account of the danger of spreading the infection, causing peritonitis. There was also uncertainty as to whether it was better to ligate or excise the veins. Again what veins should be ligated? It was argued and rightly so that if ligation of the ovarian vein was done, there was nothing to prevent the spread of the infection downward into the internal iliac vein of the same side. It was also pointed out that the ligation of the deep internal iliac vein in a person acutely ill is a difficult and uncertain operation. This is also true.

No harm can come from ligation of the common iliac on either side if there is doubt as to the presence of infection of the deeper veins of the broad ligament, especially if it extends towards the internal iliac vein. Under such circumstances it may be good prophylactic treatment and may prevent the danger of subsequent extension of the infection.

We desire to report eight additional cases making twelve in all. A careful review of these reports will show that all cases operated upon within a reasonable time after the onset of infection with one exception, recovered. The fatal ones had all been sick for periods from five to eight weeks, and at the time of operation had other complications, such as pneumonia and infections of the urinary tract, and were all in poor condition. If these three hopeless cases were deducted, and in all fairness, this should be done, there would be but one death in nine cases. It is our belief that if operation had been

undertaken in the early stages of the fatal cases, that the results would have been entirely different.

Our studies have led to the following conclusions: That diagnosis is not difficult if a careful study of the patient's condition is made. That even when there may be doubt, an exploratory laparotomy in no way interferes with the progress of the case. If a mistake is made, the patient will continue to live as she would otherwise, and hence, no harm has been done. It is not unusual that a small abscess may be discovered either in the uterus or broad ligament, which if dealt with intelligently may alone justify this exploration. Those who have experience will understand that such a condition may be accompanied by chills and a temperature similar to that found in phlebitis.

In regard to the method of procedure. The veins should be ligated through a transperitoneal incision. They need not be excised. The ligature should be placed distal to the point of infection if possible. It is probably true, however, that if this is impossible, good will be secured by a ligation of the vein somewhat short of the extreme extension of the infection, because when the blood current is interrupted the infection will cease to spread and will remain localized. We have not hesitated to ligate both ovarian veins and in one instance the vena cava. There are few apparent symptoms from such a procedure except for a moderate degree of swelling of the legs, which disappears. This is also true of ligation of both the ovarian veins and the common iliacs. In the future, our procedure will be to ligate the common in preference to the internal iliac, as it is easier and can be done more quickly. The results in so far as untoward symptoms are concerned, are no different.

It is to be hoped that the bacteriologist will come to our assistance in earlier diagnosis in the perfection of a method which will detect this apparently mild form of infection which undoubtedly circulates in the blood stream.

The mortality in the entire series of twelve cases, four of which were reported in 1912, is 33⅓ per cent. The mortality under expectant treatment of this same class of cases is certainly not less than 66 per cent. Many men believe it is higher if the milder forms are eliminated. As stated above, if four cases all of which had been seriously ill for a period of more than four weeks were deducted, the apparent results would be even better. All four were really too sick for operation and its possible aid was given only after failure for many days of other methods of treatment. The eight cases which recovered were all operated much earlier, all within a period of 19 days after the onset of symptoms and after the institution of all known methods of palliative treatment without improvement.

While our experience with operation has encouraged us to repeat it from time to time during these years, a much larger number of

cases must be reported in order to come to any definite conclusion as to its real value. It is with this spirit that we desire to add this small number to those already reported. It is our belief that no lives have been sacrificed in this study but that several patients have been saved who would have died under any other form of treatment.

CASE REPORTS

CASE 1.—*Ligation of ovarian veins and right iliac vein.* Patient aged eighteen, was admitted with a history of having been delivered at full term. Her convalescence was uneventful with the exception of a slight elevation of temperature until the 13th day when she had a chill followed by a rise in temperature. These symptoms continued for a period of six days, the temperature rising to 105°-106° and falling to 100° or below with a corresponding rise and fall in the pulse.

Bimanual examination showed tenderness on both sides of the uterus, more marked on the right. There was also thickening at the outer margin of the broad ligament on this side. The blood cultures were sterile. There was tenderness along the course of both ovarian veins. The diagnosis of phlebitis of the veins of the broad ligament with extension into the ovarian veins and possibly the right iliac vein was made.

Patient was operated upon 19 days after onset of symptoms and both ovarian veins and the right internal iliac were ligated. The veins were not excised. A protective drain was inserted into the pelvis. Patient was very sick following the operation but eventually made a good recovery. Blood cultures taken throughout the illness were always negative.

CASE 2.—*Diagnosis: Thrombophlebitis of ovarian veins.* Patient aged twenty-one was delivered of a full term child and was without symptoms until four days after delivery. On that day, she had a chill followed by an elevation of temperature. These symptoms recurred daily for four days, when she was admitted to the hospital. A study of the history and clinical chart indicated the presence of phlebitis.

Bimanual examination revealed tenderness on either side of the uterus with some thickening of the broad ligaments more marked on the left side. There was some tenderness extending upward along the course of the ovarian vein. Blood cultures negative.

Patient was operated upon on the fifth day after onset of symptoms. The right ovarian vein was thrombosed. It was ligated as high as possible and a portion of the vein resected for examination. There was extensive involvement of the lymphatics behind the peritoneum on that side. The approach had been made through a median incision which was closed after the ligation of the vessel. An incision 3 inches long parallel to and 1 inch above Poupart's ligament was then made and the peritoneum was pushed forward and a drain inserted to the base of the broad ligament. The character of the symptoms gradually changed after operation, the wide excursions of temperature gradually subsiding and the patient made a good recovery.

CASE 3.—Patient aged thirty-six, admitted to the hospital Feb. 25, 1915; normal delivery. On the fourth day after delivery there was some elevation of temperature. This gradually increased during the following 48 hours and on the sixth day, patient had a severe chill. The temperature rose to 105° following the chill. A second chill 24 hours later followed by a marked rise and fall in temperature. The same symptoms occurred on the eighth day following delivery.

Bimanual examination revealed the presence of marked tenderness on either side of the uterus, a mass on the left side apparently due to thickening within the broad ligament suggesting the presence of phlebitis. There was tenderness ex-

tending upward along the course of the ovarian vein on the left side which was most marked at a point opposite the anterior superior spine. The persistence of the symptoms which were gradually increasing in severity and the absence of a positive blood culture made the diagnosis of phlebitis of the veins of the broad ligament and probably the left ovarian vein quite certain. The patient showed evidence of severe illness and in view of the uncertainty attending palliative measures, an exploratory laparotomy was decided upon. The decision was based largely on the local symptoms and the steady progression from bad to worse in so far as the general condition of the patient was concerned.

Twelve days after the onset of symptoms, laparotomy, with ligation of right and left ovarian veins was done. Inspection revealed the presence of a considerable amount of free fluid in the peritoneal cavity. The veins of the left broad ligament were thrombosed, a similar condition extended upward into the left ovarian vein to a point opposite the anterior superior spine. The vein at this point seemed to be completely blocked and was about 3 cm. in diameter. The same condition existed on the right side but to a lesser degree. The pathologic process seemed to involve the veins along the superior border of the broad ligament merging into the ovarian vein and there seemed to be no involvement of the veins in the lower portion of the broad ligament or the internal iliac veins. Both ovarian veins were ligated and a cigarette drain was carried into the culdesac and the abdomen closed.

Patient had no more chills following the operation and the temperature gradually fell to normal within 10 days. She was discharged in one month from the date of operation in good condition.

CASE 4.—*Excision of left ovarian vein, ligation of right ovarian vein.* After an abortion of five months, patient age twenty-two, developed the characteristic signs of phlebitis, recurring chills and elevation of temperature, rising and falling in a typical manner. Her illness had extended over a period of 28 days.

On September 30, 1913, the left ovarian vein was excised after ligation, the right ovarian vein was ligated at its juncture with the vena cava. The patient improved after the operation and the record shows but one chill.

On October 8, 1913, patient developed pneumonia and died October 25, 1913.

CASE 5.—*Puerperal thrombophlebitis. Ligation of the right ovarian vessels, ligation and excision of left ovarian vein and broad ligament, left salpingo-oophorectomy, ligation of vena cava.*

This patient gave a history of having had a miscarriage one month previous to admission. For the past three weeks she had been running a temperature ranging between 104 and chills on an average of about two every 24 hours, temperature and pulse rising after the chill and then receding always with a corresponding improvement in the general appearance, pulse rate, etc. The general appearance of the patient was typical of the third week of a serious infection. The symptoms apparently were progressive gradually increasing in severity and no evidence could be found of any tendency to improvement.

Examination revealed the presence of marked tenderness along the course of both ovarian veins and there was definite palpable thickening on the left side of the uterus. There was no fluctuation and no sign of a localized abscess. The uterus was movable and somewhat larger than normal. The study of the pulse and temperature, the general appearance of the patient and the local signs were diagnostic of phlebitis of the pelvic and ovarian veins. In view of the hopeless outlook, exploratory laparotomy with the hope of ligating the vessels beyond the point of infection was decided upon.

Under spinal anesthesia, the abdomen was opened through low midline incision and free fluid found in the pelvic cavity. The sigmoid was adherent to the left broad ligament. Tube and ovary were adherent posteriorly. Palpation of left broad

ligament showed thickening. The left ovarian vein was isolated well above pelvic brim and ligated. Vein here was not thrombosed. It was divided and dissected down to broad ligament. Broad ligament then clamped below tube and ovary and mass excised. Vessels ligated and peritoneal layers partly closed, and one cigarette drain placed to left kidney fossa and one behind the left broad ligament. The right broad ligament felt normal. Ovarian vessels isolated and ligated en masse over right pelvic brim and small section excised for examination. The vena cava was isolated above the promontory of sacrum to the right of the bifurcation of the aorta. It was as thick as a finger and firm. It had a grayish color and an enlarged gland was lying on its surface. It was isolated and ligated with No. 2 catgut in the thrombosed portion.

One cigarette drain was placed to this and brought out through the lower end of the incision. Incision closed. The right adnexa was inflamed and fibrin was present on surface of ovary.

The vena cava was ligated because of the great difficulty in dissecting out both internal iliac veins and with the possible danger even though this could be done satisfactorily that the infection might still spread through some of the smaller vessels. The patient withstood the shock of operation fairly well and was certainly no worse for having undergone the procedure. There were no chills after the operation and the temperature gradually fell in spite of the presence of a septic pneumonia. The patient lived for 20 days and in the end died of pneumonia which had been present at the time of operation. There was pain and swelling of the left leg with marked tenderness along the course of the veins. This was apparently an ordinary phlebitis and not secondary to the ligation of the veins above. There was some edema of the right limb below but it was not excessive. There seemed to be very little perceptible effect in so far as the ligation of the vena cava was concerned, as the collateral circulation seemed to be quite sufficient. There was very little doubt that, had the same operation been done ten days earlier, the outcome would have been different.

CASE 6.—*Thrombophlebitis of ovarian veins. Laparotomy, ligation of left ovarian vein.* Patient aged twenty-six, delivered at fifth month. Was admitted to the hospital five days later with a history of elevation of temperature and general symptoms of infection. Since admission, the temperature has been running a typical course, characteristic of a localized infection. There have been one or two chills every 24 hours, followed by a marked rise to 103-104°, and then falling to 100° or thereabouts. The symptoms are very typical of phlebitis. The patient has complained of pains in the left lower quadrant of the abdomen and physical examination reveals the presence of a mass in the broad ligament on that side. It gives the impression of a thickened condition secondary to a lymphangitis or phlebitis of the veins in the broad ligament. The right side is free from enlargement. The uterus is larger than it should be at this time. There is no evidence of any infection in the femoral or saphenous veins. The blood cultures have been sterile.

There is little doubt that the symptoms are due to a localized infection either extending through the lymphatics or the veins of the broad ligament. The absence of a considerable amount of pelvic exudate and the severity of the chills and the persistence of serious symptoms justify the diagnosis of phlebitis with its typical train of symptoms. The general condition is very poor, the blood pressure being low, the systolic scarcely 90 and the diastolic about 50. The systolic at the wrist with the finger only shows a pressure of 68. This indicates the gravity of any surgical procedure and yet one feels justified in breaking off this infection if possible, and the procedure contemplated is to be a ligation of the ovarian veins together with the vena cava above its bifurcation.

Operation: Anesthesia: Ether, and local. Midline incision. Exploration revealed the presence of a mass on the left side of the uterus extending from the

middle of the broad ligament to the brim of the pelvis, which consisted of a thickening of the tissues and some enlargement of the Fallopian tube. The ovary was about four times the normal size. From the outer margin of the broad ligament extending upward behind the peritoneum, an enlargement about 2 cm. in diameter was distinctly palpable. It extended upward gradually diminishing in diameter to the renal vein. The entire mass from the broad ligament upwards was very firm in its consistency and of a blue color. The ureter was closely adherent throughout. The condition was that of a typical phlebitis, which involved the veins in the outer portion of the broad ligament extending into the ovarian vein above. Two double catgut ligatures were placed high as near the renal vein as possible. No palpable enlargement could be detected in the veins behind the uterus, namely, the internal iliacs or the right ovarian. There was very little free fluid in the pelvic cavity.

Within three days after operation, the patient's temperature fell to normal. There were no more chills and while the convalescence was slow, owing to some delay in the healing of the wound, the patient made a good recovery.

CASE 7.—*Thrombophlebitis of the right ovarian vein. Lymphangitis of right broad ligament.* Admitted to the hospital complaining of chills, fever and lower abdominal pain. Symptoms caused by an induced abortion. During succeeding 17 days, patient had recurring chills followed by elevation of temperature. Examination revealed a tender mass on the right side of the uterus. The temperature and other symptoms were typical of an infection within the veins. This, however, seemed to be complicated by the presence of a possible infection within the cellular tissues of the broad ligament. Operation was done 18 days after the onset of symptoms by my associate, Dr. Cashman.

Local and ethylene anesthesia: The right ovarian vein was found thrombosed and with a surrounding lymphangitis formed a firm cord the size of the index finger extending to the vena cava. Exploration of the mass above referred to revealed the presence of an abscess secondary to the lymphangitis within the broad ligament. This was incised and about two ounces of pus evacuated. Double ligatures were placed about the ovarian vein at the highest possible point. On account of the presence of pus, one cigarette drain was placed in the culdesac and one to the abscess cavity.

The convalescence in this patient was complicated by a severe pyelitis which caused some elevation of temperature, otherwise patient made an uninterrupted recovery. The symptoms which were present previous to operation disappeared at once. Blood culture previous to operation showed Bacillus coli infection. The same infection was found present from pus in the abscess at operation.

CASE 8.—Primipara, aged eighteen, normal delivery. Within 48 hours the patient had a chill followed by a sharp elevation of temperature. It was succeeded by a remission to normal. During the next four days her clinical condition was characterized by daily chills with sharp elevations of temperature to 105° to 106°, succeeded by marked remissions and profuse sweating. During the following week the temperature showed a tendency to subside, with occasional elevations. On the nineteenth day postpartum, the patient developed an acute tenderness in the left inguinal region, with tenderness along the course of the saphenous vein and edema of the leg below the knee. Her temperature rose to 103° with corresponding increase in pulse rate. From the 19th to 29th day postpartum, the temperature fluctuated between 98° and 105°. From the 30th to the 79th day postpartum, the clinical course has been characterized by severe rigors followed by elevation of temperature ranging from 105° to 108° with corresponding increase in pulse rate and succeeded by remissions with profuse sweats. Not infrequently, these chills lasted from one to one and one-half hours. On the 30th day, patient began to

complain of pain in the right renal region. Urine showed albumin, many pus cells and granular casts. Patient was seen by the writer December 30th, forty days after the onset of infection.

Examination revealed tenderness along the course of both broad ligaments with slight induration, more marked on the left side. Blood count showed at this time, Hb. 26 per cent, R.B.C. 1,670,000, W.B.C. 30,000, P.M.N. 91 per cent. Diagnosis: Phlebitis of veins in broad ligament with probable extension into the internal iliacs. Pyelonephritis. Patient seemed hopelessly ill and operation not advised. She was seen again January 9th and while the symptoms had in no way abated, there seemed to be some temporary improvement in the general condition of the patient. In view of the absence of any response to any form of treatment including the use of blood transfusions, antistreptococcic serum, etc., it was decided that in spite of her poor physical condition, that some benefit might be derived from an operation. On January 9, under ethylene and local anesthesia, a laparotomy was performed. The right ovarian vein showed definite thickening and the presence of infection. The left was normal. The deep internal iliac veins were thickened, indurated and corrugated to the touch. In view of the serious condition of the patient no attempt was made to ligate the internal iliacs. Both ovarian veins were ligated. In order to save time and yet include the infected area, it was decided to ligate the vena cava. This was presumably done, but it was found later at autopsy, that instead of the vena cava, the left common iliac vein had been ligated. This happened for two reasons: First, the junction of the common iliacs was very high and the left ran in the normal position of the lower portion of the vena cava. At this stage of the operation, the patient came out of her anesthetic compelling undue haste, and in this way our landmarks were lost. This mistake was discovered at autopsy. It demonstrated, however, that ligation of both the ovarian veins and common iliac are not followed by serious symptoms. The left limb was swollen moderately for a few days only. Examination of the right kidney at the time of operation showed it to be about twice the normal size. There were no chills for three days after operation, when they again recurred. The urine at this time was loaded with pus cells, and pain and tenderness in the right kidney increased. Catheterization of the ureters revealed many pus cells and red blood cells from the right kidney. The patient's symptoms persisted and in view of the definite evidence of infection in the right kidney, and the apparent ability of the patient to continue to withstand the infection, it was finally decided to remove the right kidney. This was done January 23rd, fourteen days after the first operation. Following the nephrectomy, the patient had four chills in as many days, the last chill occurring on January 27th. The temperature, save for three elevations to 100° was normal. Patient developed numerous superficial abscesses. A diagnosis of endocarditis had been made previous to her first operation, and symptoms of this complication still persisted. Patient began to lose ground the week following nephrectomy and died suddenly thirteen days after operation.

Autopsy showed acute bronchopneumonia, multiple abscesses of both lungs, multiple abscesses of spleen, acute tubular and glomerular nephritis.

Our only reason for reporting this case is to show that in spite of the grave illness which had lasted over a period of weeks, with recurring chills and high temperatures, we were able to perform two major operations, without in any way lessening her chances for recovery. The complications of infection of the kidneys, myocarditis and multiple abscesses, necessarily precluded her chances of recovery. It was a case in which the infection was wide-spread and not amenable to surgical measures.

(*For discussion see page* 613.)

PRESENT STATUS OF THE INDUCTION OF LABOR BY MEANS OF PITUITARY EXTRACT*

By W. A. Scott, B.A., M.B., F.A.C.S., Toronto, Ont.

THE object of the investigation which forms the basis of this paper was a desire to know how many obstetricians were using pituitary extract to induce labor, either with or without other drugs, and their opinions of the value of such a method. The indications for the induction of labor vary so greatly that we were not concerned with the discussion of that phase of the subject, but inquired only about the method of induction. Of course it is obvious that if one feels that there is at hand a safe method of starting labor, and especially one not requiring mechanical interference, one will likely feel justified in inducing it in many cases where there would be a hesitancy to use a method that was either dangerous or technically difficult. I also wish to incorporate in this paper a report of our results since the last paper by Dr. P. B. Watson.

Previous to Dr. Watson's[4] first publication in 1913 there were a few accounts in the literature of similar attempts, the earliest of which was by Fries[1] in 1911. Studeney[2] in the same year recorded two attempts and Stein and Dover[3] in 1917 recorded 34 cases of induction at term by means of castor oil and quinine. The first publication by Watson[5] was in 1920, in which he was successful in 53 out of 62 cases. Mendenhall[7] in 1921 reported some satisfactory results at term, but usually combined with other procedures. Mahnert[8] in the same year used it once for induction in a case of albuminuria with twins. Cron[9] in 1922 reported 45 cases ranging from the eighth month to three weeks past the expected date. He combined it with castor oil and quinine and was successful in 65 per cent. Dr. Watson's[3] third paper in 1922 reported 276 cases in which 90 per cent of the attempts were successful, with no maternal deaths and a fetal mortality just over 6 per cent. In a discussion of this paper Culbertson stated that he succeeded in inducing labor in a large proportion of cases with oil and quinine alone, but had also used pituitary without mishap. Johnson[10] in the same year stated that she was using the method, but had reduced the dose of pituitary and had yet to see any evil results. Cleveland[11] on the other hand was of the opinion that only rarely, and in very large doses would it bring on labor at term. Haskell and Rucker[12] from an experimental study arrived at the conclusion that pituitary is more dangerous in the early stages of labor than ergot, as it is more

*Read at the Fifty-first Annual Meeting of the American Gynecological Society, Stockbridge, Mass., May 20, 1926.

prone to produce either a tetanus or an increase in tone than the latter drug. Steinberg[13] did not succeed in inducing labor with pituitary during an investigation of its action, but thinks that the contractions induced by this drug when used to initiate labor simulate normal contraction more than those which are induced during labor. Brown[14] gave a very comprehensive report of the results in Edinburgh, where it has been the routine since 1921. He was successful in 40 out of 44 cases and all the failures were in premature cases. He "has been able to find no case in the literature in which rupture occurred as a result of pituitary induction." There were 4 stillbirths in the early part of his series, but none in the last 30. J. Whitridge Williams[15] in 1924 followed the Watson technic and was successful in about 75 per cent of cases near term. He did not think its value was great in cases of toxemia because it was useless before the last two months. In a personal communication he states that these views remain the same. Blair Bell[17] in a recent article says he uses it for induction if the child is dead or to obviate the possibility of disproportion between the child and the pelvis. He feels it is contraindicated in uncompensated heart disease. Pouliot[18] in reporting a symposium on the use of pituitary leads one to feel that it is not used in France for the induction of labor but is apparently widely used once labor is established. Parache[19] is opposed to the Watson technic as using too much pituitary. He ruptures the membranes and after waiting from two to four hours gives 1 c.c. of pituitary. If not successful he waits some hours and then gives another dose.

In the attempt to obtain a more comprehensive idea of the value of this method than could be obtained from the literature, a questionnaire was sent to representative obstetricians. One hundred and twenty-one replies were received, all of which were from obstetricians who are Fellows of the American College of Surgeons or of the American Gynecological Society. Seventy-eight of these men are not now using the method, some of them having never attempted it and others abandoning it after a longer or shorter trial.

Of the seventy-eight who do not use the method twelve gave no reason except the fact that they had seen or had heard of accidents when pituitary had been given *during* labor. Throughout the investigation difficulty was encountered due to confusion between the use of the drug once labor was established and its use for induction. One man in this group had seen "bad results when pituitary was used in two cardiac cases," but he did not state whether it was given for induction or not. Another states that he thinks it should be classed as a criminal offense to use it to either induce or hasten labor. Fourteen felt it had no place in obstetrics when we have mechanical means which are so positive and two of these men also felt that pituitary was liable to cause the retention of pieces of placenta. H. M. Little

of Montreal uses oil and quinine before inserting a bag and F. S. Newell of Boston says that most of their inductions are for toxemia before term and a bag is then more reliable. Seven do not use the method because others have found it unsuccessful. Sixteen have tried it and have either failed to induce labor or have had such a small percentage of success that they have gone back to mechanical means. One of these men thinks "it never initiates labor." W. E. Welz, of Detroit, tried 100 cases at term some years ago with no success and had little better results with the Watson method, while F. A. Dorman of New York is of the opinion that it sometimes causes a partially dilated cervix to close. A. W. Bingham of East Orange uses it when the membranes have been ruptured and W. F. Grosvenor of Chicago uses pituitary after inserting a bag. Seventeen replied that they did not use the method but gave no reasons. Eight stated that they were afraid of tetanic uterine contractions. Some of these men have seen such contractions and others have heard of them. W. A. Fowler of Oklahoma City formerly used it at term in small doses after oil and quinine, but has discontinued it because "of an increase in the tonicity of the uterus between pains" and states that he was partially influenced in this opinion by the work of Haskell and Rucker. Irving W. Potter of Buffalo is opposed to induction by any means and J. C. Litzenberger of Minneapolis is awaiting further evidence before trying the method. Two induce only for toxemia and think that the method is then contraindicated.

Forty-three obstetricians are using the method but with varying technics although the majority are using only slight modifications of Dr. Watson's method. Paul Titus of Pittsburgh depended upon oil and quinine until a year ago when he began the Watson method, which he has used in 25 consecutive cases, and R. H. Luikart of Omaha has had slightly over this number. He as well as F. J. Taussig of St. Louis is opposed to the Watson technic but uses small doses of pituitary starting with two minims and increasing slowly according to the reaction. He often loosens the lower pole of the membranes and has the uterus massaged at five-minute intervals. W. C. Danforth of Evanston, Ill., has used it since Dr. Watson's first paper, but with three minim doses and he also loosens the membranes with the finger. C. B. Reed of Chicago has used it at term in 93 cases with two failures and has discovered no dangers. He puts the method below the bag in uncertainty and above it in ease and simplicity of management. A. B. Spalding of San Francisco has had about one hundred and fifty inductions with this method while F. L. Adair of Minneapolis has used the method for years and his opinion remains much the same as in his original article[16] except that he no longer hesitates to use it in toxic cases with hypertension. Palmer Findlay states that he has used it many times and C. Jeff Miller has used it freely since Dr. Watson's

first paper, but has decreased the dose to five minims. He has found that it succeeds more frequently if the patient be kept in bed. B. C. Hirst of Philadelphia has used oil, quinine and pituitary for years, with success in the majority of cases.

The bad results that follow the use of this method are very largely the results of tetanic contractions of the uterus. Smith and McClosky[20] have shown that some of the preparations on the market are as much as eight times as strong as others. With the new international method of standardization of the drug it is likely that this disadvantage will be overcome, but there will still remain the undoubted fact that patients vary in their reaction to the drug. J. Whitridge Williams believes that the fetus is occasionally endangered by these severe contractions, and consequently they now use it only when there are strict indications for induction. Brown[14] had two cases of such contractions, one of which followed packing of the vagina three days after the last dose of pituitary and the child was lost; the other case was induced at thirty-five weeks for a contracted pelvis, chloroform controlled the spasm and a live child was born. Taussig of St. Louis and L. A. Wilson of Charleston each had a case of a multipara with a very rapid labor after its use. R. H. Luikart of Omaha had one tetanic contraction with a dead baby in a series of twenty-five cases. A second one had a precipitate labor and a torn cervix when a nurse gave a further dose after labor was established. A. W. Bingham and J. O. Polak each had one case of detached placenta, the former in a patient to whom he had given pituitary two days before and the latter following a tetanic contraction produced by 5 c.c. of pituitary in small doses. Theodore Miller of Cleveland saw a case in consultation where induction was attempted at eight months. Two doses of 1 c.c. each were given and were followed by a tetanic contraction. He prescribed ¼ gr. morphia and spontaneous labor came on two weeks later with a dead baby. F. C. Irving of Boston saw one case of violent contractions and a stillborn baby, while L. E. Leavenworth of Canton had two cases but both babies were born alive and normal. P. W. Toombs of Memphis saw one case with evident disproportion where consent to a section could not be obtained. Labor was induced with pituitary and tetanic contractions resulted. The heart tones ceased and the patient was delivered by craniotomy. Titus in twenty-five consecutive cases had one of fetal distress and this was delivered by forceps and a second with a precipitate labor and a left lateral tear of the cervix. This patient was given a further dose after labor had started. As regards danger to the mother two cases of rupture of the uterus were encountered. Fordyce[21] reported the first one, his patient being a para xi at term. Her previous children were all large and she had had six difficult deliveries with one craniotomy. She was given three doses of 0.5 c.c. each at one half hour intervals and one

half hour later ordinary pains began and the membranes ruptured. There were two pains in the next quarter of an hour, the second being long and severe. There were no further pains and fifteen minutes later she showed signs of distress. The cervix was found to be nearly dilated with a tear running up into the posterolateral wall. A large baby and placenta were removed from the peritoneal cavity by laparotomy. Fordyce points out that several cases of rupture in the first stage had been reported where no pituitary had been used.

The second case is an unpublished one, the details of which were given me in reply to the questionnaire by Ross Mitchell of Winnipeg. Neither the obstetrician nor the senior intern was present. Labor was induced with castor oil and quinine and pituitary. There was a malpresentation with the left hand and arm flexed around the neck and the hand alongside the chin. The patient died as the result of a partial rupture of the lower segment from the extension of an old cervical laceration.

I now wish to give a brief report of our results since Dr. Watson's last paper. We have tried this method 198 times since the last report, 82 of these cases being from my private practice. Ninety-four of my private cases were included in the previous report making one hundred and seventy-six times that I have attempted this method in private practice. In one hundred and ninety-eight cases we failed to induce seventeen times and of these failures seven were induced subsequently by bag and one was delivered by section after three attempts at induction. This latter case was being induced on account of a small pelvis and the section was done at term. Fifty-nine of these patients were primiparae and one hundred and thirty-nine multiparae.

Of the 181 cases where we succeeded in inducing labor we had 151 normal deliveries, twenty-three forceps, eight breech cases and two craniotomies, one for a hydrocephalus and one for a brow presentation after seventy-two hours in labor. There were three cases of twins. Seven cases were induced by means of oil and quinine alone and in eight cases labor was induced by means of pituitary without previous oil and quinine.

In this series, including the unsuccessful cases, there were eighteen dead babies. Of these, three were induced because of a diagnosis of a dead fetus and two were craniotomies as noted above. Of the remaining thirteen:

One was a case where an unsuccessful attempt was made two weeks before term. Labor began spontaneously at term. The patient had a contracted pelvis, a version was done and the child killed in delivery.

One was a prolapsed cord in a primipara with a breech presentation. The child was alive at the beginning of delivery.

Three were cases of placenta previa, two of which had severe bleeding.

Two were in cases of twins, the first baby in each case being born alive.

Three were induced for toxemia of pregnancy, two of the patients having had convulsions.

One followed a first stage of sixty hours, when the patient was three weeks past the expected date. The next labor was induced at term with a live baby.

Two followed apparently normal labors.

There were two cases of sharp bleeding; one before the birth of the placenta, controlled by manual removal and one after the birth of the placenta, controlled by a further dose of pituitary.

In two instances the placenta was retained, one coming away spontaneously in two hours and the other being removed manually.

Three cases had tetanic contractions of the uterus, all of which were controlled by an anesthetic and all of these babies were alive.

One patient developed an abscess in the hip at the site of injection.

There was one maternal death. This was a primipara sent in from the conutry with the vagina packed on account of bleeding from a placenta previa. Labor was induced with oil, quinine and one dose of pituitary. Following a forceps delivery of a living child there was a profuse hemorrhage and the patient died in thirty minutes.

CONCLUSIONS

1. There is no method of inducing labor that is absolutely free from danger to either mother or child.

2. The induction of labor by the use of pituitary after castor oil and quinine is practically free from maternal danger if properly used.

3. This method has some dangers for the child even with the best of technic and this danger is considerably increased by improper use of the method. This danger consists for the most part of the evil results of the occasional tetanic contractions which result, but such contractions can usually be controlled by the administration of an anesthetic.

4. There is almost unanimous opinion among those using this method that the original dosage as proposed by Dr. Watson is too large and they either use smaller doses throughout or start with smaller doses and increase slowly.

5. The method is being used much more extensively than one would gather from the literature, and those who have used it in a considerable number of cases are, for the most part, continuing to employ and have confidence in it.

6. There is considerable confusion in the minds of many between the use of pituitary to induce labor, as opposed to its use during labor.

7. It cannot be emphasized too strongly that when pituitary is used

to induce labor, it should not be repeated once pains are established. To give the drug under such circumstances is the same as giving it early in the first stage of labor and there is no question about such a procedure being fraught with great danger.

REFERENCES

1Fries: München. med. Wchnschr., Nov. 14, 1911.
2Studeney: Wien. klin. Wchnschr., Dec. 21, 1911.
3Stein and Dover: Med. Rec., 1917, ii, No. 90.
4Watson, B. P.: Can. Med. Assn. Jour., September, 1913.
5Watson, B. P.: Trans. Amer. Gyn. Soc., 1920.
6Watson, B. P.: Am. Jour. Obst. and Gynec., 1922, iv.
7Mendenhall: Indianapolis Med. Jour., 1921.
8Mahnert: Med. Klin., 1921, xvii.
9Cron: Amer. Jour. Obst. and Gynec., 1922, iii.
10Johnson: Med. Record, 1922, ci, 379.
11Cleveland: New Orleans Med. and Surg. Jour., lxxiv, 760
12Haskell and Rucker: Amer. Jour. Obst. and Gynec., 1922, iv.
13Steinberg: Amer. Jour. Obst. and Gynec., 1924, vii, 82.
14Browne: Obst. Trans. Edin., Vol. 44, 1923.
15Williams: Jour. Amer. Med. Assn., 1924, lxxxiii.
16Adair: Interstate Med. Jour., xxiii, No. 2.
17Bell, Blair W.: Brit. Med. Jour., 1925, vol. 1027.
18Pouliot: Rev. franc de gyn. d'obst., 1925, xx.
19Parache: El Siglo Med., Madrid, 1923, lxx, 525.
20Smith and McClosky: Bull. 138. Hyg. Lab. U. S. P. H. S., April, 1922.
21Fordyce: Trans. Edin. Obst. Soc., 1923, xliv.

160 Bloor Street West. (*For discussion see page* 610.)

LIVER FUNCTION TESTS IN THE TOXEMIAS OF PREGNANCY*

By Edward Lacy King, A. B., M.D., F.A.C.S., New Orleans, La.
(Assistant Professor of Obstetrics at Tulane University)

MANY tests have been devised for the study of the various functions of the liver, but of the many articles in the literature dealing with this subject during the past few years, only a few treat specifically of the application of these tests to the study of the toxemias of pregnancy. It will be well, therefore, to consider the work which has been done by others along this line before passing to a consideration of my results in a series of tests performed upon 24 patients suffering from these disorders of pregnancy.

One of the first investigators to employ functional liver tests in these toxemias was Walthard,[1] who published the results of his investigations in 1922. After careful and elaborate studies of the blood sugar, the storage capacity of the liver for glucose administered by vein or by mouth, the bilirubin content of the urine, and the rest nitrogen of the blood, he concludes that there is a hyperglycemia and an impairment of the storage ability of the liver in normal pregnant

*Read, by invitation, before the American Gynecological Society, May 20-22, Stockbridge, Mass.

The work herein reported was aided by a grant from the David Trautman Schwartz Research Fund of Tulane University.

women during labor, and that there is also an increase in the urobilin content of the urine. These findings, he believes, cannot be explained on the basis of excessive muscular effort during parturition, as severe exertion on the part of normal pregnant women did not produce similar results. Analogous findings, however, have been noted in diabetic women after severe exertion, and from this Walthard concludes that there is normally some impairment of liver function during labor (the so-called Geburtsleber), which tends to clear up rapidly during the puerperium. In eclampsia Walthard found marked disturbance of liver function, as evidenced by a considerable elevation of the blood sugar, a marked depression of the storage capacity for glucose, and an increase of the rest nitrogen of the blood. The urobilin content of the urine showed no characteristic change.

Williams,[14] in 1922, reported the results obtained by employing the phenoltetrachlorphthalein test of Rosenthal in twenty pregnant women. One was in the sixth month, two were tested the first day postpartum, while the others were from seven to nine months pregnant. Fifteen of these patients were healthy, two were nephritic, while three were toxic patients with albuminuria who were evidently not nephritic. The dye was given intravenously, and the time of its first maximum appearance in the bile obtained through the duodenal tube was noted. In the normal cases this point was reached in from 16 to 24 minutes, with an average of 20 minutes. In the pathologic cases this period of time was variable, being 19 minutes in a nephritic patient with convulsions, while in the others the time was 20, 22, 25, and 28 minutes, respectively. In view of these variable results in patients in whom liver damage might reasonably be expected, the author concluded that further studies would be necessary in order to ascertain if the method has any value in such cases. It is interesting to note that in the nephritic case with convulsions, the appearance time was within the normal limits. This corresponds with case 10 of my eclamptic series (see table); this patient was really suffering from a very severe nephritic toxemia, and there was no retention of the bromsulphalein. I might also note that the duodenal tube method was soon superseded by a colorimetric method (devised by Rosenthal) of estimating the percentage of retention of the dye in the blood stream, and this latter method was employed by the authors mentioned below.

Smith[2] of the Boston Lying-In Hospital, employing the phenoltetrachlorphthalein test of Rosenthal, studied 20 clinically normal pregnant women and 44 pregnant women suffering from varying degrees of toxemia. In the former group he found occasional slight degrees of retention; in the latter group the test gave normal readings in 24 cases, while retention was noted in 20 instances. Of the 24 patients who reacted negatively to the test, 2 developed convulsions, one of whom died; autopsy revealed very slight liver damage. Of the 20 patients who showed retention of the dye, 5 had convulsions, while 6 of the 20 died from toxemia, operative shock, or infection (one case). Smith concludes that definitely abnormal dye retention suggests that the toxemia is severe, but that the percentage of retention does not in all cases parallel the degree of liver damage. As the severely toxic conditions will be readily recognized by clinical observation alone, it is possible that the chief value of this test in pregnancy will be as an aid in the classification of the milder toxemias.

Naujoks[3] employed this test in 20 patients suffering from the various toxemias of pregnancy, and reaches practically the same conclusions as Smith. He believes also that the test should be especially valuable in deciding for or against therapeutic abortion in cases of hyperemesis gravidarum.

Krebs and Dieckmann[4] used the Rosenthal test in a study of 37 patients with symptoms or physical signs indicative of varying degrees of the toxemia of pregnancy. They report no cases of eclampsia. Some of the patients gave normal readings and a few showed marked retention, but in the majority of instances the test indicated only moderate impairment of liver function, and the findings in the main appeared to agree fairly well with the clinical pictures presented. In two groups, however, one composed of patients with high blood pressure and no symptoms of toxemia, the other composed of patients with toxic symptoms but normal blood pressures, the test indicated dysfunction of the liver in most instances. The authors are of the opinion that such findings indicate a developing toxemia. In 6 patients who showed retention of the dye before delivery, the test 10 to 12 days postpartum was uniformly negative, while in 12 normal pregnant women it was uniformly negative. The authors feel that the test offers considerable promise in the study and management of the toxemias of pregnancy.

Rosenfield and Schneiders,[5] working with the same dye, found normal excretion in 6 cases of uncomplicated pregnancy. In 7 cases of hyperemesis gravidarum the test corresponded with the clinical picture, and in some instances disclosed impairment of liver function before it was manifested clinically. In 9 patients suffering from hypertension, retention in varying degrees was noted. The test returned to normal in every instance in which clinical improvement was noted. The authors feel that the test is of definite value as an index to treatment, particularly when therapeutic abortion or the induction of labor is under consideration.

Couinaud and Clogne,[6] employing the digestive hemoclasis test of Widal and the study of the excretion of glycuronic acid in the urine following the ingestion of camphor, advocate the determination of liver function by this method. Additional studies were made by them on the toxicity of the urine and on the intermittent renal elimination observed in cases of hepatic insufficiency.

Tallerman,[7] in studying the effect of the ingestion of levulose on the blood sugar, found no evidence of liver dysfunction in normal pregnancy. In three cases of the toxemia of late pregnancy studied by this method there was but one positive reading; this patient had a severe eclamptic attack.

Hyn and Messtorf,[8] working with the hemoclastic crisis test of Widal, found it to be positive in one-third of a series of healthy women in the last month of pregnancy. Didier and Phillips[9] obtained positive readings in 35 per cent of 26 apparently healthy pregnant women, and Kobarth[10] obtained a similar result in 56.2 per cent of 32 similar cases. Couinaud and Clogne also obtained positive reactions in the majority of healthy pregnant women upon whom they performed this test.

Of particular interest is the work of Berkeley, Dodds and Walker,[11] who studied the question of liver function tests in the toxemias of pregnancy as a guide to the induction of labor. They employed the Fouchet test for bile pigment in the blood, Ehrlich's test for urobilinogen in the urine, Schlessinger's test for urobilinuria, and Lowenhart's method of estimating the blood lipase. Control tests were made on known healthy students, as well as on patients definitely affected with various disorders of the liver. In 10 cases of albuminuria in pregnancy without toxic symptoms all tests were negative, and in no instance did a demonstrable toxemia develop. In 17 pregnant women with albuminuria and symptoms of toxemia the tests were likewise negative; the patients were allowed to proceed to term without induction of labor, and in no instance did eclampsia develop. Seven patients with albuminuria and definitely toxic symptoms reacted positively to all tests, and of these seven, four developed eclampsia before pregnancy could be terminated. I might add here that I have employed these tests (with the exception of the blood lipase estimation) in several cases of toxemia of late pregnancy, as will be detailed later, and I have failed to duplicate the results of these authors. One hesitates to differ with Comyns

TABLE I

LIVER FUNCTION TESTS—ECLAMPSIA

AGE	PARITY	MAXIMUM BLOOD PRESSURE	N. P. N.	CREATININE	URIC ACID	P. S. P.	VAN DEN BERGH	BROMSULPH.	EHRLICH	FOUCHET	SCHLESSINGER	REMARKS
24	1	180	34	1.4	3	33%	Neg.	40%. Trace 2 days P.P.	—	—	—	Severe case. Child dead in utero on admission
19	1	160	37	2	5	—	Neg.	Trace	Neg.	Neg.	Neg.	Mild, postpartum type, 4 convulsions. Child stillborn prior to admission
34	1	210	Max. 75	Max. 3.53	Max. 8	—	—	5% 3 days P.P.	—	—	—	Very toxic, probably nephritic, 2 convulsions. Child stillborn. 2¾ lbs.
17	1	160	30	1.5	5.3	—	Neg.	Neg.	—	—	—	Mild, postpartum type. Developed puerperal psychosis. Child born before admission.
20	1	230	Max. 75	Max. 3.11	Max. 11.4	—	—	35%. 10% 8 days P.P.	—	—	—	Extremely toxic, hyperpyrexia, anuria. Child dead in utero on admission. 15 convulsions, coma
16	1	150	30	1.2	4.5	40%	—	Neg.	Neg.	Neg.	Neg.	Mild case, 8 convulsions, child lived
19	1	165	30	1.2	5	40%	—	7.5%	Neg.	Neg.	Neg.	Mild case, 10 convulsions, child lived
21	1	155	38	2.1	5	40%	—	5. %	Neg.	Neg.	Neg.	Mild case, 3 convulsions, child lived
17	1	160	39	3	2.5	35%	—	25 %	Neg.	Neg.	Neg.	Mild case, 9 convulsions, child lived
23	1	168	Max. 264	Max. 6	Max. 8	0%	Neg.	Neg.				Probably nephritic, 16 convulsions, died of bronchopneumonia

TABLE II

LIVER FUNCTION TESTS—TOXEMIA WITHOUT CONVULSIONS

AGE	PARITY	MAXIMUM BLOOD PRESSURE	N. P. N.	CREATININE	URIC ACID	P. S. P.	VAN DEN BERGH	BROMSULPH.	EHRLICH	FOUCHET	SCHLESSINGER	REMARKS
35	7	190	30	.8	5	—	Neg.	25%, later 0%	—	—	—	Bag induction. Child lived. 5 lbs. 3 oz.
39	7	165	30	1.5	4	50%	Neg.	Neg.	Neg.	Pos.	Neg.	Labor induced by Watson's method. Full term, child lived
28	3	200	37	2	5	37%	—	Neg.	Neg.	Neg.	—	Premature separation of placenta, death of child in first stage of labor
34	3	142	26	1.1	3	60%	—	Neg.	Neg.	Neg.	Neg.	Mild case; improving. Not yet delivered
30	7	240	35	2	4	30%	Neg.	40% before delivery; 20% 2 days P.P. Trace 10 days P.P.	—	—	—	Bag induction. Stillborn twins, first anencephalic; second hydrocephalic with spina bifida
20	1	175	37.5	1.2	4	48%	Neg.	Neg. twice before delivery	—	—	—	Bag induction. Child lived
26	3	190	57	2	6.1	20% twice	Direct delayed Indirect 4 units	Neg. error?	—	—	—	Chronic nephritis and myocarditis. Induction by catheter and pituitrin. Child died 1 hr. after birth
34	6	200	30	1.2	2.5	40%	—	Neg.	Neg.	Neg.		Full term, induction of labor. Child lived
23	6	190	37	2	4	35%	—	15%	Neg.	Pos.	Neg.	Induction of labor. Twins; first child macerated, second lived
40	7	170	92.1	2.6	7.24	5%	—	—	Neg.	Neg.	—	Chronic nephritis. Premature separation of placenta. Child dead in utero on admission.

Berkeley, and it may be that further work will supply an explanation for my negative findings, but at present I can only record my results.

In this investigation I have employed the bromsulphalein test of Rosenthal and White,[12] the Van den Bergh and Fouchet tests on the blood serum, and the Ehrlich and Schlessinger tests on the urine. The Van den Bergh tests were performed by Dr. T. A. Tumbleson of the Department of Medicine of Tulane University, to whom my thanks are due for his cooperation. The study includes eleven cases of toxemia without convulsions, ten of eclampsia, and three of severe vomiting of pregnancy. A detailed consideration of the results may be of interest.

Bromsulphalein (phenoltetrabromphthalein sodium sulphonate) was introduced in 1925 by Rosenthal and White,[12] who claim that this dye has none of the disadvantages of phenoltetrachlorphthalein, which was previously popularized by the work of Rosenthal, who simplified and perfected the technic of its employment. Instead of the three readings necessary with phenoltetrachlorphthalein, only one is required when the new dye is used. Five milligrams per kilogram of body weight are injected intravenously; a blood sample is withdrawn at the end of half an hour, and the dye content of the serum is estimated with the aid of a special colorimeter. In patients with no pathologic changes in the liver no dye should be found at the expiration of this interval of time; if retention of the dye is disclosed by the test, the authors claim that the percentage of the retention parallels the degree of liver injury.

I found that this test, when employed in cases of toxemia without convulsions, was negative in the milder types, as well as in those patients whose toxemia was nephritic rather than preeclamptic in origin. It was positive in 4 cases, and in another instance a possible error in technic may have affected the result, though the negative reading might have been expected, as the patient apparently belonged in the nephritic group. One patient gave a reading of 25 per cent the day following delivery (labor had been induced by a bag), but a week later the test was negative. The second patient who reacted positively was very ill, and most probably belonged in the preeclamptic group, as evidenced by a nonprotein nitrogen reading of 35.1 and a systolic blood pressure of 240. In this instance the first reading, the day before delivery, showed a 40 per cent retention of the dye; the second test the following day gave a reading of 20 per cent; eight days postpartum there was still a slight retention, and it was not until the seventeenth day that the test was negative. In both these patients the test indicated severe liver damage, especially in the second case, and the findings coincided with the clinical pictures. The two other patients who reacted positively gave readings of 15 per cent and 25 per cent, respectively. The first was not very toxic, but

the second had a systolic blood pressure of 190, and there was considerable albumin and acetone in the urine. The test was not repeated in either case.

In the ten cases of eclampsia the test was negative in only three instances. One of these patients was suffering from a toxemia of a very mild type; in another patient with postpartal eclampsia the results were vitiated by an error in technic. In the third case there is no doubt that we were dealing with chronic nephritis complicated by convulsions. The phenolsulphonephthalein test was zero on two occasions, and the nonprotein nitrogen was 264 the day before death, which occurred six days after admission. This patient was the only one in the series who died, and the immediate cause of death was bronchopneumonia; the toxemia had been markedly improved.

The seven other cases gave readings varying from a trace to 25 per cent retention, and in every instance the percentage of retention agreed fairly well with the clinical findings and the laboratory data. In the three cases of hyperemesis gravidarum the bromsulphalein test gave positive results, varying from 10 to 25 per cent retention. Clinical improvement was apparently associated with lower readings, but definite conclusions cannot be drawn from so small a number of cases.

The Van den Bergh test[13] is based upon Ehrlich's diazo reaction and is both qualitative and quantitative. It also distinguishes between bilirubinemia due to obstruction of the biliary passages and that caused by increased destruction of the red cells by hemolysis. The standard matches a dilution of 5 mg. bilirubin per liter of blood volume. This is the unit of comparison. Normally there is found 1 to 3 mg. of bilirubin to the liter of blood, so that the normal reading is 0.2 to 0.6 units. In this study this test was found to be uniformly negative in the nonconvulsive toxemias, and in eclampsia as well, even though in many instances the blood was withdrawn immediately after admission, in the intervals between convulsions. In one patient in the nonconvulsive type, it is true, the test showed a mild grade of bilirubinemia of the nonobstructive type (2 units), but this patient presented a complicated clinical picture of chronic nephritis and chronic myocarditis, with increased fragility of the red cells, the cause of which could not be determined. On the other hand, the Van den Bergh test was positive in all three cases of hyperemesis gravidarum, and the readings paralleled the clinical findings.

Fouchet has devised a test for bilirubin in the blood serum, which is much simpler than the Van den Bergh test, although not so delicate. It detects bilirubin in a dilution of 1 to 60,000. Three drops of the serum are mixed on a white porcelain surface with three drops of the reagent (20 c.c. of water, 2 c.c. of a 10 per cent solution of ferric chloride, 5 gm. trichloracetic acid). A white coagulum is formed, which, if the reaction is positive, turns a greenish yellow, reaching

the maximum color in about twenty minutes. This test was positive twice in six patients of the nonconvulsive type. In the first case, with a rather mild toxemia, the Van den Bergh test was negative, and we could find no explanation for the discrepancy. In the second instance, in which the Van den Bergh test was not done, the toxemia was of a severer type. In the eclamptic group the test was employed five times and in each instance the reaction was negative. It was not used in any of the cases of hyperemesis gravidarum.

The urinary tests for urobilinogen and urobilin are based upon the fact that normally these substances are absorbed from the intestines by the blood, are carried to the liver, and are there converted into biliverdin and bilirubin. If the liver is not functioning properly, this conversion is interfered with and these compounds are excreted in the urine. Traces of these substances are normally present in the urine, but the tests used in this work will detect only pathologic amounts. Ehrlich's paradimethylaminobenzaldehyde test is used in examining for urobilinogen, while Schlessinger's zinc chloride fluorescence test detects pathologic amounts of urobilin. These tests were employed in six patients of the nonconvulsive group and in five of the eclamptic group, with negative readings in every instance. They were not employed in the three cases of hyperemesis gravidarum.

From this review of the experience of others, supplemented by my personal observations, I feel that the following conclusions are justified:

1. Phenoltetrachlorphthalein and its successor, bromsulphalein, are of definite value as liver function tests in the toxemias of pregnancy. They are of service in differentiating between the nephritic and preeclamptic types of toxemia. The degree of retention seems to correspond with the clinical findings.

2. The Van den Bergh test is uniformly negative in nephritic toxemia, preeclamptic toxemia and eclampsia, except in an occasional case with excessive bilirubin in the blood caused by some independent condition. In hyperemesis gravidarum, on the contrary, it appears to be constantly positive for bilirubin of the nonobstructive type. This apparently substantiates the theory that the pathology of toxemic vomiting of pregnancy is essentially different from that of the toxemias of late pregnancy.

3. The Widal hemoclastic crisis test does not appear to be of value as a liver function test in pregnancy.

4. The Fouchet test for bilirubin in the blood serum has proved unreliable in a small series of cases of toxemia of pregnancy.

5. The same is true of the Ehrlich and Schlessinger tests for pathologic amounts of urobilinogen and urobilin in the urine.

6. The dye tests, as well as the studies on the blood sugar and on the storage and mobilization of glucose and levulose, indicate that in the toxemias peculiar to pregnancy there is definite impairment of the liver function.

REFERENCES

[1]Walthard: Arch. f. Gynäk., 1921-22, cxvi, 68-97; Zentralbl. f. Gynäk., August 12, 1922, xlvi, 1301-1303.
[2]Smith: Am. Jour. Obst. and Gynec., September, 1924, viii, 298.
[3]Naujoks: Zentralbl. f. Gynäk., 1925, xlix, 2755.
[4]Krebs and Dieckmann: Am. Jour. Obst. and Gynec., January, 1924, vii, 89.
[5]Rosenfield and Schneiders: Jour. Am. Med. Assn., March 17, 1923, lxxx, 743.
[6]Couinaud and Clogne: Gynec. et Obst., May, 1923, viii, 372-387.
[7]Tallermann: Quart. Jour. Med., October, 1923, xvii, 37.
[8]Hyn and Messtorf: Klin. Wehnschr., June 11, 1923, ii, 1114.
[9]Didier and Phillips: Presse Med., June 15, 1921, xxix, 473.
[10]Kobarth: Zentralbl. f. Gynäk., Nov. 25, 1922, xlvi, 1883.
[11]Berkeley, Dodds, and Walker: Jour. Obst. and Gynec., British Empire, Spring, 1924, xxxi, 1.
[12]Rosenthal and White: Jour. Am. Med. Assn., April 11, 1925, lxxxiv, 1112.
[13]Van den Bergh: Presse Med., June 4, 1921, xlv, 441.
[14]Williams, P. F.: Am. Jour. Obst. and Gynec., July, 1924, iv, 26-30.

Maison Blanche Building. (*For discussion see page* 611.)

FUNCTION OF THE OVARY, A RÉSUMÉ*
FIFTH PAPER

By Robert T. Frank, A.M., M.D., F.A.C.S., New York, N. Y.

SINCE 1911 I have made it a self-imposed task at intervals to bring before the Society such advances as have been made in our knowledge of the ovary.[1] I am glad to be able to report that since my last paper, in 1924, substantial advance can be recorded.

At this, the fiftieth anniversary of the founding of the American Gynecological Society, it is appropriate to call attention to some papers of fundamental importance written by members of the Society or read before our association. In 1875 George J. Engelmann wrote a paper on "The Mucous Membrane of the Uterus,"[2] which is as modern today as when first published. He recognized the cyclical changes which were again rediscovered by Hitchman and Adler[3] in 1908. In 1877, John C. Dalton, in the second volume of our transactions, published a classic description of the human corpus luteum.[4] These are a few instances of early reports which unfortunately were pigeon-holed and forgotten for many years.

It is not necessary again to review the entire physiology of the ovary because the fundamental facts have become familiar to all of you. I shall therefore take for granted that you are aware of the work of the pioneers, such as Knauer, Halban, etc.,[5] and confine my

*Presented at the Fifty-first Annual Meeting of the American Gynecological Society, Stockbridge, Mass., May 20, 21 and 22, 1926.

exposition to the newest advances which, with a few gaps as yet unfilled, enable us to form a clear idea of the function of the ovary and its importance to the feminine organism.

The female gonads elaborate a hormone which has never been isolated in a chemically pure form but has been obtained in a sufficiently pure state to enable us to use it for pharmacologic and physiologic experimentation.[6] I feel no hesitation in assuring you that this hormone, which Gustavson and I call the "female sex hormone," is elaborated by the maturing follicle,[7] by the corpus luteum,[6] and perhaps by the placenta, although, as I wrote in 1917, the placenta may merely be a storage reservoir for the hormone elaborated by the ovaries.[8]

The hormone is of importance in fetal life and continues of vital significance until the menopause arrives. Contained in the placenta, this hormone affects the fetus in utero, producing stimulation of the mammary gland in both male and female, and in the female of the tubular system (vagina, uterus, and tubes) as well. In the infant and adolescent female the ovaries elaborate a small quantity of this female sex hormone although the dosage is extremely small and can barely suffice to exert the necessary trophic influence on the immature sexual organs.

With the first ovulation, which marks the onset of puberty, the maturing follicle elaborates larger amounts of the female sex hormone which, as I shall show later on, enters the circulating blood and stimulates the tubular tract to its first cyclical changes.

In 1917, as part of the symposium on internal secretions which was prepared for the Society, I had made notes to read to you of experiments then under way. On the day on which I was leaving for Pittsburg, I was called into active military service and therefore was unable to present the new facts which I had just determined. I shall read the final paragraph as copied from the notes made at that time.

> "The cyst fluid derived from the ripening follicles has a stimulating action upon the uterine musculature and mucosa. This last observation appears to give experimental proof of the contention of the physiologist that estrus is initiated by the ripening of the graafian follicles."

I had no opportunity of publishing this observation until 1922,[7] and since 1923 my findings have been amply confirmed by numerous investigators.[9] In the follicle fluid the female sex hormone is found in considerable concentration.

Years before this observation was made, the female sex hormone had been demonstrated in the corpus luteum and in the placenta,[6] in greater concentration in the latter than in the former. Although the presence of the hormone in the corpus luteum has not been confirmed by all investigators,[10] the fact that the chief doubters have now conceded that they can find the active substance in the human corpus luteum,[11] should be considered as decisive, because no physiologist or

zoologist can give serious consideration to the hypothesis of Allen, that the primate corpus luteum alone contains the hormone, for the corpus luteum is found from the monotremes up throughout the vertebrate series. The reason that it has not been demonstrated in the lower species by these observers is due to lack of proper methods of concentration.[12] Gustavson and I have explained the seeming incongruity that corpora lutea at the time of beginning involution contain more of the hormone than the recent more active corpora lutea, by pointing out the relation of the lutein cells to the capillary circulation which enables the active substance to enter the blood stream as it is formed, so that no storage takes place until the capillaries commence to obliterate.[6]

The next step was the demonstration of the active substance in the circulating blood (published by Loewe,[13] July 15, 1925, and independently by Frank, Frank, Gustavson and Weyerts[14] on August 15, 1925).

The female sex hormone, to repeat, has been shown to be elaborated by the growing follicles, the corpus luteum and the placenta and to be circulating in the blood in a demonstrable quantity at the time that the estrus approaches and during the beginning of the estrus. To this I may add that quite recently (report as yet unpublished) Goldberger and I have found the hormone in considerable concentration circulating in the blood of pregnant women, from the beginning of gestation to at least the sixth month of pregnancy. We have as yet not had an opportunity to examine the blood of patients further advanced in pregnancy.

Let us try to draw such deductions as are justified from these observations and see to what they lead.

Kingery, Gustavson and I[15] not only have shown that puberty may be induced in very immature animals, as previously known, but also that when the threshold of artificial puberty has been passed, the immature female organism is able and does continue this premature cyclical function without further stimulation. In the feminine organism puberty, therefore, sets in when the threshold of elaboration of the female sex hormone has been reached. The ovary, through its follicle, secretes the active substance. The tubular tract receives this substance through the circulating blood, responds to the stimulation by undergoing muscular and endometrial hyperplasia, the vaginal mucosa also responding to the effect of the hormone (Stockard and Papanicolaou[16]) (Papanicolaou[17]). These changes in the lower forms we are accustomed to call the preestrual change. In the human female these changes are familiar to you all under the name of premenstrual, better denominated pregravid reaction. In the animals studied the acme of the reaction is reached at the period called estrus at which time alone coitus is accepted; in the human female the passing of the highest point of the reaction is marked by menstruation.

It is now time to discuss some as yet unpublished results made by Goldberger and myself on the human female, which will shortly appear in the Journal of the Am. Med. Assn.[18] We have noted that the amount of the female sex hormone present in the circulating blood varies greatly during the menstrual cycle, an abrupt increase taking place especially noticeable one to two days before the menstrual flow is due, but present in some instances as early as thirteen days before the period occurs. The highest concentration is noted immediately before the onset of the period. With the onset of menstruation the hormone abruptly disappears from the general circulation (i.e., is no longer demonstrable by our present methods), but during the first day of the menses, sometimes during the second day also, the hormone is found in the menstrual excretion in a strength of from five to fifteen times that noted in the circulating blood.

Based upon these observations, the following generalizations can be made. They were enunciated by Gustavson and myself[6] even before these last corroborative observations had been added. The function of the adult ovary consists in elaborating a hormone which produces two types of cycles. The one we have called the fertile or complete sex cycle, consisting of maturation of the follicle with its attendant tubular reaction (pregravid reaction), ovulation, impregnation, the elaboration of the corpus luteum, nidation, and pregnancy. Pregnancy is attended by the formation of a placenta which in turn sends the female sex hormone into the circulation and assures the continued hyperplasia of the uterus and accessory sex organs throughout pregnancy. Its acme is reached with the onset of labor.

The other, called the short, infertile or abortive sex cycle, does not differ from the fertile one until ovulation has taken place, impregnation for one reason or another having been prevented or not occurring. The corpus luteum then involutes rapidly and therefore the acme of the reaction is reached at estrus in the lower forms or at the time in the human female when the female sex hormone is excreted in the menstrual flow. It is, of course, evident and self-understood that the main, in fact the sole, function of the female sex organs is for the perpetuation of the species. To emphasize this function of follicle, corpus luteum and placenta, we call them collectively "the gestational gland."

Parenthetically I might add that the recent publication of Papanicalaou[19] in which he has demonstrated a hormone (if this be really a true hormone) obtained from the corpus luteum, which suppresses the maturation of the follicles and therefore interferes with ovulation, must be kept in mind. This substance if secreted at regular intervals might account for the rhythmic perpetuation of the cycle, a fact hitherto not fully explained by Leo Loeb's experimentation in which he showed that the removal of the yellow body produced an acceleration

of follicle growth and hence anticipation of the cycle, in addition to the formation of the maternal part of the placenta which he demonstrated as the function of the yellow body.[20]

On the other hand, Evans[21] has demonstrated that an extract from the anterior lobe of the hypophysis likewise represses ovulation. This investigator ascribes the cessation of ovulation in the rat as due to lutein cell transformation of the ovarian follicles.

It must also be remembered that in addition to the substances described by Papanicolaou and Evans, apparently quite nonspecific influences, such as changes in environment or food-supply may also interfere with the cycle. In one instance the blood of a human female contained a large amount of female sex hormone, such as is found just before menstruation (due four days later). The patient gave 500 c.c. of blood for transfusion of blood for her sick child. After this abstraction of hormone-containing blood, menstruation was postponed for fourteen days. For the present, therefore, we deem it expedient to leave the question as to whether the periodicity of the cycle is due to summation of the amount of female sex hormone following ovulation and corpus luteum formation until the yellow body becomes functionless, or to an inhibitory mechanism ascribable to either corpus luteum or hypophysis, or both, entirely open.

On this occasion I will refrain from describing again the physiologic methods of assaying by means of which it is possible to demonstrate the presence of the female sex hormone.[22] These methods are readily accessible in the literature. I do desire, however, to emphasize once more that Gustavson and I[6] have been able to demonstrate by three different methods that the hormones obtained from the follicle fluid, the corpus luteum and the placenta, are identical.

The blood test which Goldberger and I at present employ is still difficult, cumbersome and time consuming (the details of technic will soon appear, probably in the Journal of the American Medical Association). We hope to improve the technic so as to make it easier to use. The test has already proved of value (*a*) in differentiating types of amenorrhea, one type being due to absence or subthreshold quantity of circulating hormone, the other resembling the amenorrhea of pregnancy although impregnation has not taken place and which, at least until further evidence has accumulated, we ascribe to persistence of the corpus luteum; (*b*) in distinguishing certain types of menorrhagia and metrorrhagia, because it appears that irregular bleeding may be due to an over- or underproduction of the active substance. In one case of long persisting and severe prepuberty metrorrhagia, excess of the hormone was found in the circulating blood; (*c*) in the diagnosis of early pregnancy in which, however, the amenorrhea of pregnancy may have to be differentiated from the amenorrhea due to the persistence of the corpus luteum; (*d*) in the determination of sex in the

presence of malformation or hermaphroditism, on which a preliminary note will soon appear.[23] In two instances in individuals with absent vagina, and no palpable uterus or ovaries, the female sex hormone was readily obtained from the circulating blood. Further study may show additional uses for the test.

Since the presence of the hormone in the circulating blood has come to my knowledge, I have been more than ever impressed by the severe nervous and other symptoms from which certain women suffer before the onset of their menstrual period. These symptoms may be explained by the accumulation of an excessive amount of the female sex hormone in the system, particularly as these women almost unanimously notice that with the onset of the menstrual flow (through which the hormone is excreted) these annoying and sometimes incapacitating troubles are at once relieved. The symptoms in the main consist in a disturbance ascribable to the vagus nerve and the nervus pelvicus. This opens a broad field for further physiologic investigation.

In conclusion I desire to reiterate the fact that we have made no real advance in our attempts to employ ovotherapy, although I feel more and more confident that sooner or later we will have at our command a new, potent and useful therapeutic agent. The really potent agent, I also feel sure, from the poisoning symptoms just described, will have to be employed with the utmost circumspection until we know its dosage and poisonous effects.

REFERENCES

[1]Frank, R. T.: The Function of the Ovary, Surg. Gynec. and Obst., 1911, xiii, 36; 1914, xix, 618; 1917, xxv, 329; Am. Jour. Obst. and Gynec., 1924, viii, 573.

[2]Englemann, G. J.: The Mucous Membrane of the Uterus with Special Reference to the Development and Structure of the Decidua, Am. Jour. Obst., 1875, viii, 30.

[3]Hitchmann, F., and Adler, L.: Der Bau des Uterus Schleimhaut des geschlechtsreifen Weibes mit besonderer Berücksichtigung der Menstruation, Monatschr. f. Geburts. u. Gynäk., 1908, xxvii.

[4]Dalton, J. C.: Report on the Corpus Luteum, Trans. Am. Gynec. Soc., 1877, ii, 3.

[5]Knauer: Die Ovarialtransplantation, Arch. f. Gynäk., 1900, lx, 332.

Halban, J.: Ueber den Einfluss der Ovarien auf die Entwicklung des Genitals.

Heape, W.: The Menstruation of Semnopithecus entellus, Phil. Trans., 1894, clxxxv, 411.

Heape, W.: The Sexual Season of Mammals and the Relation of Proestrum to Menstruation, Quart. Jour. Micro. Sc., 1901, xliv, 1.

[6]Frank, R. T., and Gustavson, R. G.: The Female Sex Hormone and the Gestational Gland, Jour. Am. Med. Assn., 1925, lxxxv, 84.

[7]Frank, R. T.: The Ovary and the Endocrinologist, Jour. Am. Med. Assn., 1922, lxxviii, 181.

[8]Frank, R. T.: The Placenta Regarded as a Gland of Internal Secretion, Surg. Gynec., and Obst., 1917, xxv, 329.

[9]Allen, E., and Doisy, E. A.: An Ovarian Hormone, Jour. Am. Med. Assn., 1923, lxxxi, 819.

Hart, C. P., Jongh, Laqueur and Wijsenbeck: Ueber das Hormone des Ovariellen Zyklus, Deutsch. Med. Wchnschr., No. 41.

Zondek and Aschheim: Zur Funktion des Ovariums, Klin. Wchnschr., 1926, v, 400.

[10]Doisy, E. A., Rawls, J. O., Allen, E., and Johnston, C. G.: The Extraction and Some Properties of an Ovarian Hormone, Jour. Biol. Chem., 1924, lxi, 711.

11Allen, E., Pratt, J. P., and Doisy, E. A.: Ovarian Follicular Hormone, Jour. Am. Med. Assn., lxxxv, 399.
12Correspondence, Frank, R. T.: The Corpus Luteum as a Source of the Follicular Hormone, Surg. Gynec. and Obst., 1926, xlii, 572.
13Loewe, S.: Klin. Wchnschr., 1925, iv, 1407.
14Frank, R. T., Frank, M. L., Gustavson, R. G., and Weyerts, W. W.: Demonstration of the Female Sex Hormone in the Circulating Blood, Jour. Am. Med. Assn., 1925, lxxxv, 510.
15Frank, R. T., Gustavson, R. G., and Kingery, H. M.: Analysis of Factors Producing Puberty, Jour. Am. Med. Assn., 1925, lxxxv, 1558.
16Stockard, C. R., and Papanicolaou, G. N.: The Existence of a Typical Oestrous Cycle in the Guinea Pig, with a Study of Its Histological and Physiological Changes, Am. Jour. Anat., 1917, xxii, 225.
17Papanicolaou, G. N.: The Diagnosis of Early Human Pregnancy by the Vaginal Smear Method, Proc. Soc. Exper. Biol. and Med., 1925, xxii, 436.
18Frank, R. T., and Goldberger, M. A.: The Female Sex Hormone. IV, Its Occurrence in the Circulating and Menstrual Blood of the Human Female, Jour. Am. Med. Assn., 1926, lxxxvi, 1686.
19Papanicolaou, G. N.: Specific Inhibitory Hormone of the Corpus Luteum, Jour. Am. Med. Assn., 1926, lxxxvi, 1422.
20Loeb, L.: Function of the Corpus Luteum, Med. Rec., June 25, 1910.
21Flower, C. F., Forkner, C. E., Kellum, W. E., Walker, A. T., Smith, P. E., and Evans, H. M.: Stability of Hormones in the Anterior Hypophysis; Separation of the Principle in the Anterior Hypophysis Affecting Ovulation from that Controlling General Body Growth, Anat. Rec., 1923, xxv, 107.
22Frank, R. T., Gustavson, R. G., and Bonham, C. D.: A New Method of Assaying the Poteney of the Female Sex Hormone, Am. Jour. Physiol., 1925, lxxiv, 395. See also reference 6.
23Frank, R. T., and Goldberger, M. A.: The Female Sex Hormone. V, A New Method of Determining Sex in the Presence of Malformation of the Gential Organs, Jour. Am. Med. Assn., 1926, lxxxvii, 554.

10 East Eighty-fifth Street. (*For discussion see page* 617.)

THE VALUE OF CAUTERIZATION OF THE CERVIX BEFORE HYSTERECTOMY*

By B. Z. Cashman, M.D., Pittsburgh, Pa.

SINCE 1920, when Polak[1] advocated total hysterectomy in fibroid tumors there has been considerable discussion as to the advisability of doing total hysterectomy in all cases requiring removal of the uterus. Polak collected 256 case reports of cancer in the retained cervical stump after subtotal hysterectomy. All of those cases occurred more than one year after operation. Previous to this paper, subtotal hysterectomy was the operation of choice for benign conditions of the uterus, while total hysterectomy was undoubtedly the choice procedure in malignant conditions.

The chief advantage claimed for subtotal over total hysterectomy in benign conditions is that it is a less formidable operation. There is less extensive opening of the lymphatic spaces; the vagina is not opened; there is less danger of trauma to the ureters, and the exposure is less difficult, which in many cases must lessen the hemorrhage, shock, and danger of complications. In simple cases total hysterec-

*Read, by invitation, at the Fifty-first Annual Meeting of the American Gynecological Society, Stockbridge, Mass., May 20, 21 and 22, 1926.

tomy is not much more formidable than subtotal hysterectomy, but in stout patients with deep pelves, or extensive adhesions, or where there is marked fixation of the cervix by contracted parametrial tissue and uterosacral ligaments as a result of long-standing inflammatory processes in the cervix, or when there are large fibroids in the lower portion of the uterus, making exposure difficult, total hysterectomy is a very much more difficult procedure and with poor exposure there is more chance of hemorrhage, shock and of injury to the ureters, regardless of the skill of the operator. A less important advantage of subtotal hysterectomy is the preservation of the normal vault of the vagina.

The arguments advanced in favor of subtotal hysterectomy are valid, particularly in the poor surgical risks. On the other hand, the great advantage of total hysterectomy is that the cervix is removed. Cervicitis due to gonorrhea or secondary to lacerations is so common that in the majority of subtotal hysterectomies, a diseased cervix is left behind. As a result the patient may have leucorrhea, sacral backache, soreness in the pelvis and the other symptoms due to chronic lymphangitis or parametritis that result from cervicitis, and it has been shown that malignant disease occurs in the remaining cervical stump more frequently than was generally supposed. While emphasis has been placed upon removal of the cervix in operation for fibroids, are we justified in leaving a diseased cervix in any case requiring hysterectomy?

With these facts in mind we have attempted to secure the advantages of subtotal hysterectomy and eliminate its disadvantage, namely, leaving a diseased cervix. In November, 1924, the author[2] reported some histologic studies of the cervix after cauterization with the electrocautery. It was found that the cervical mucosa and glands can be destroyed in the majority of cases. The cervix was cauterized and immediately amputated in some cases. In others, previously cauterized cervices in which healing had taken place were obtained for examination after total hysterectomy later. In these specimens, the cervical glands were completely destroyed.

The technic used differs from that originally advocated by Hunner[3] in that the cauterization is completed at one sitting. The cervix is dilated and the entire cervical canal is cauterized, and deep radial incisions are made at the external os, extending well onto the vaginal portion of the cervix. In this manner the cone-shaped, gland-bearing portion of the cervix is destroyed by a simple rapid method. If this is done as the first step in subtotal hysterectomy, there is accomplished practically all that is accomplished in total hysterectomy, and the disadvantages of total hysterectomy are eliminated. As a result of this procedure, the cervical mucosa and glands are destroyed, the cervix heals smoothly without a lumen and no after-treatment or dila-

tation is necessary, and the normal vault of the vagina is preserved. Although the most common point of origin of cervical cancer is in the vaginal portion of the cervix, if the infected cervical mucosa is destroyed the danger of cancer is eliminated, for cancer of the cervix does not occur in the absence of chronic cervicitis.

Another immediate advantage of cauterization of the cervix is that it insures a sterile field in cutting across the cervical canal in doing subtotal hysterectomy.

We have been using the cautery for seven years in the treatment of cervicitis, not only preliminary to subtotal hysterectomy but also in practically all operations for infected tubes, and in cervicitis without intraabdominal complications. We have not seen a case of carcinoma develop in a cervix treated in this manner, while in the last two years we have seen three cases of carcinoma of the cervix in patients who, within three years, had had pelvic operations in which an inflamed cervix was neglected. This is quite suggestive. The important point is not whether the patient has had fibroids or whether she has had subtotal hysterectomy, but whether a diseased cervix is present.

This method is applicable to all cases except in very extensive cystic disease of the cervix, where in order to reach all of the cysts so much of the cervix must be destroyed by the cautery that amputation of the cervix with the cautery is preferable. Cautery amputation of the cervix is a rapid, practically bloodless procedure and usually requires no sutures or ligatures.

CONCLUSIONS

1. Subtotal hysterectomy is a less formidable operation than total hysterectomy, but has the disadvantage of leaving, too often, a diseased cervix.

2. Cauterization of the cervix preliminary to subtotal hysterectomy destroys the infected cervical tissue and makes total hysterectomy unnecessary in benign conditions of the uterus.

REFERENCES

[1]Polak: Total Hysterectomy in Fibroid Tumors of the Uterus, Jour. Am. Med. Assn., Aug. 28, 1920, p. 579.
[2]Cashman: The Cautery Treatment of Chronic Cervicitis, with Histologic Studies, Am. Jour. Obst. and Gynec., 1924, viii, 628.
[3]Hunner: Jour. Am. Med. Assn., 1906, xlvi, 191.

226 South Evaline Street. (*For discussion see page* 621.)

Society Transactions

THE AMERICAN GYNECOLOGICAL SOCIETY

FIFTY-FIRST ANNUAL MEETING

STOCKBRIDGE, MASS., MAY 20, 21, AND 22, 1926.

DR. HAROLD BAILEY, New York City, read a paper entitled **Trial Labor in 477 Cases of Contracted Pelves (Conducted under One Plan of Treatment during the Last Four Years).** (For original article see page 550.)

DISCUSSION

DR. FRANCIS A. GOLDSBOROUGH, BUFFALO, N. Y., (by invitation).—This paper of Dr. Bailey's is a very timely one, particularly for my end of New York State, because in the last few years the decision to do cesarean section there is based on apparently no particular thought or consideration so far as the outcome of a trial labor is concerned. It seems to me that in a great many instances the cesarean is decided upon because it is so much easier to say, this patient cannot have a baby and we will have to do a cesarean section than it is to study the case and see whether the baby can be gotten through the pelvis with safety.

In one of the hospitals in Buffalo 9 per cent of all patients were delivered by cesarean section, and to my mind there is no excuse for that. On account of the criticism of high forceps and of long tests of labor made a few years ago by some obstetricians, those less well informed in obstetrics have taken the point of view that cesarean is preferable but the results have not been good, as shown by Dr. Bailey.

In cases of but slightly contracted pelvis the patient should not be allowed to go over term and to have a very large baby. In such instances induction of labor at term will help in the outcome both for the mother and child.

In my part of the State of New York they are coming to the point where a breech presentation or a shoulder presentation even with normal pelvis is considered suitable for cesarean section. I should like to ask Dr. Bailey whether he attempts to make an estimate of the particular pelvis and the particular baby in a breech presentation; whether he would allow a labor to take place with the idea that he can determine in a given case that the aftercoming head will come through the pelvis, or whether it is a routine procedure in anything except the vertex presentation to do a cesarean?

Dr. Bailey's results in regard to the tests of labor are very excellent, and I agree with him that we can do the low section with very little greater risk than doing cesarean section earlier. If one will observe his cases carefully he will meet with the same agreeable surprises that Dr. Bailey has, namely that a large percentage will have spontaneous or comparatively simple delivery.

DR. ALEXANDER M. CAMPBELL, GRAND RAPIDS, MICHIGAN, (by invitation).—Dr. Bailey was kind enough to quote some statistics which we made in Michigan in 1913 concerning the mortality resulting from cesarean section. We have been

getting statistics on this subject for a number of years and while our last figures are not complete, so far as they have been gathered they show practically the same maternal and fetal mortality as Dr. Bailey reports from the State of Massachusetts.

Our latest statistics in Michigan show that cesarean section has a maternal and a fetal mortality each approximating 10 per cent. I assume that in this respect Michigan represents a cross section of every State in the Union and, therefore, think that Dr. Bailey is justified in sounding a warning note against the indiscriminate use of cesarean section. He states that there is a wave of meddlesome midwifery sweeping over the country and this is certainly true also for the Middle West.

I have been informed on good authority that in a certain Philadelphia Hospital one cesarean section is performed in every six pregnancies and that in a hospital in the city of Toronto only one cesarean section is performed in over 700 deliveries. These statements prove striking lack of unanimity in regard to this important problem.

I would not have the courage to permit a woman to remain in hard labor for twelve hours without either rectal or vaginal examinations because I want to know more definitely the degree of dilatation present. I would like to ask whether Dr. Bailey's test of labor means that the labor continues until the cervix is completely dilated and how he can tell the degree of dilatation without examination.

In every case of contracted pelvis we make an x-ray study which helps us to determine the safest means of delivery in the case. In every delivery we endeavor to maintain such a careful technic that cesarean section could be performed at any time with the minimum danger of infection. Concerning the newer transperitoneal low flap cervical cesarean section I doubt that within the near future it will supplant the classical operation. Dr. Bailey's statistics are excellent but the operation which he performs is more difficult, more time consuming and is associated with more hemorrhage, and these disadvantages must be taken into consideration. I believe that the ordinary operating surgeon will have just as high a mortality and just as much morbidity from the newer operation as from the classical.

Our own experience with the classical operation has been most satisfactory.

DR. BARTON COOKE HIRST, PHILADELPHIA, PA.—I find myself in full accord with the views expressed. There is no question that cesarean section is being much abused. A practice to be deprecated is referring these cases to a general surgeon with no knowledge of obstetrics. I was talking to a general surgeon in a small town recently who was boasting of the number of cesarean sections he had done. At a rough computation it seemed if his rate continued, one fifth of the whole population were being delivered in this manner.

For twenty years or more we have been following the custom of giving a primipara 24 hours of test labor and a multipara 12 hours and we have not seen any disadvantage to the woman or the child in a cesarean section which subsequently became necessary. It is not essential to do the low cesarean in all these cases of test labors; our statistics show about as favorable result with regard to mortality and morbidity with the old-fashioned high operation.

DR. WILLIAM C. DANFORTH, EVANSTON, ILL.—There is a tendency of late for cesarean sections to be done too frequently and the low cervical operation has also suffered from this in that it has been used no doubt in cases which did not require cesarean at all.

For the past three or four years we have been following essentially the same program which Dr. Bailey has outlined. All cases except those with absolute indications for abdominal delivery have been allowed to go into labor. They have

been given a true test of labor. Within the past month three cases of relative contraction have been so managed in private work with the result that all three delivered spontaneously or with a simple outlet forceps. We do feel, however, after having tried out both operations rather extensively, that the low cervical cesarean operation in a woman who has been in labor is preferable. The patients have a better and smoother convalescence and I am quite convinced that the risk of death is less, but it has the disadvantage of being a more difficult operation.

DR. FRANK W. LYNCH, SAN FRANCISCO, CAL.—The frequency of cesarean section is not confined to the East. I had the questionable pleasure of discussing a paper within the last two weeks of a gentleman of the coast who reported some 240 cases of cesarean section in a series of less than 4,000 labors, all of which his paper indicated had had the test of labor. It was rather embarrassing for me because in a series of approximately 6500 cases, we had done only 32 cesareans as opposed to his 240. I called attention to the fact that Dr. Reuben Peterson in 1913 calculated a tremendous mortality for the State of Michigan, and an assistant of mine, in 1922 had figured the mortality for California as 12 per cent, even though he had difficulty to complete the percentages because so many operators had refused to give their mortality figures.

DR. RUDOLPH W. HOLMES, CHICAGO, ILL.—We were all duly impressed when Dr. Reynolds many years ago showed that primary cesarean section was infinitely safer than a secondary operation. From the results of my work I convinced myself that it was relatively immaterial whether a woman was in labor or not, provided she was not exhausted, and provided that membranes had not been ruptured for a protracted period: supplementing this, interferences during labor increased the patient's hazards. I feel very strongly that a true test of labor only may be given if the membranes are ruptured—but the rupture of the membranes surely places the woman in jeopardy.

The fundamental defect of our teaching is that too much stress is laid upon the pelvic measurements, which are relatively unimportant, and do not accentuate the essential of cephalo-pelvic relationship: there is a great need for a precise method of mensuration of the head. After all that is said and done, the most efficient method of determining cephalo-pelvic proportion is a sane test of labor.

I believe x-ray is a very valuable adjunct to our methods of determining the cephalo-pelvic relationship.

I am glad that Dr. Bailey did one craniotomy as it confirms my contention that the operation is a perfectly legitimate one, even on a living child under exceptional circumstances: I have performed only one craniotomy on a living child in many years—and that was on a young woman who had suicidal tendencies before and during pregnancy, whose family was permeated with insane members. In her case, I felt, a craniotomy was more humane than a cesarean section.

DR. JOSEPH L. BAER, CHICAGO, ILL.—The time limit of twelve hours seems rather an arbitrary test, particularly in primiparæ, and I believe that twenty-four hours for primiparæ and twelve hours for multiparæ is a much more reasonable limit.

I believe that a 38 week induction in a multipara is an entirely legitimate procedure and often obviates the necessity for graver obstetric interference.

I wish to mention in this connection a case delivered a week ago at the Michael Reese Hospital. The patient was a multipara who had had a 28 hour difficult labor preceding this pregnancy, with successful termination by high forceps. I saw patient after labor had gone on for about twelve hours and made a diagnosis of face presentation with non-engagement. I recommended a low section but ordered as we do in pathologic cases as a routine, that an x-ray picture be taken before the

cesarean. The patient was ready on the table and the operators scrubbed up when the radiologist hurriedly brought a splendid picture showing an anencephalus. The patient was delivered vaginally four hours later.

DR. WILLIAM S. STONE, NEW YORK CITY.—It is rather surprising to me that in the discussion of this important obstetric problem more attention is not given to the consideration of the size of the fetal head. My thesis for admission to this society was entitled "Antepartum Measurement of the Fetal Head." The experience that I gained from carrying out these measurements with the ordinary pelvimeter enables me to estimate the size of the head with an accuracy sufficient to foretell the course of labor. Errors were very few. I would again urge more consideration of this part of the problem.

DR. JAMES R. GOODALL, MONTREAL, CANADA.—I do not think that any of us will take issue with Dr. Bailey's statement of the unnecessary frequency of cesarean section. But I think most of us will take issue with him in his methods of determination of test of labor.

The real test of labor begins only after complete dilatation of the cervix and rupture of the membranes. How does Dr. Bailey estimate the stage of labor after four hours of pains if he does not examine his patient digitally to find out?

Doubtless a very large percentage of Dr. Bailey's patients who underwent cesarean section after four hours of test labor were still in the first stage and therefore as far as the pelvic contraction is concerned had had no real test of labor.

DR. EDWARD A. SCHUMANN, PHILADELPHIA, PA.—I wish to introduce a note of dissension into this otherwise harmonious discussion. In the first place, the gross mortality statistics of cesarean section are valueless as a method of evaluating the elective operation. Such statistics include all neglected, "too late" cases, those performed by incompetent and inexperienced operators and have no bearing whatever upon the results of deliberate operations undertaken by specialists.

Now as to the relative mortality and morbidity of a long, manual or instrumental vaginal delivery as opposed to elective sections of any type. When one considers the number of women with sacro iliac relaxation, with sagging pelvic organs and with ragged and irregular cervical orifices, results too frequently occurring in the practice of our very best men, one is tempted to believe that elective section carries with it no appreciable increase in mortality and an immeasurable improvement in morbidity.

It is absurd to condemn an operation and to seek to limit its employment, because of calamities occurring in unskilled hands, or because the procedure has been employed upon improper indication.

DR. LILIAN K. P. FARRAR, NEW YORK CITY.—It was the teaching and the practice of Schauta of Vienna, never to do a cesarean section on a primipara with a contracted pelvis if she had been long in labor, if the membranes had ruptured, or if she had been examined outside the clinic, but to give her a test of labor and terminate the labor by the vaginal route even if it meant the loss of the child, and in the next pregnancy, to do a cesarean section when labor was due, if the previous labor had been unsuccessful. It seems to me to be better obstetric teaching to give a patient a trial labor and then perform a selective cesarean section in the following labor. After having been an obstetric patient for twelve hours a woman is not fit to become a surgical case. We would not choose to perform a surgical operation on a woman who had been doing twelve or twenty-four hours of hard work, or who had any avenue open for infection.

DR. N. SPROAT HEANEY, CHICAGO, ILL.—What the general practitioner wants to know from a Society like this is how to tell when a baby can be born, and what constitutes a test of labor. Many cesareans are done because a patient has been twelve hours in labor and has not delivered. But we all know that under certain conditions such a patient if given a dose of morphine, may have labor cease for hours or days and deliver precipitately later. We should tell the physicians what really constitutes a test of labor, but there does not seem to exist any unanimous opinion even among us as to what really is a test of labor.

DR. J. C. LITZENBERG, MINNEAPOLIS, MINN.—I had not intended to discuss this paper but the remarks of Dr. Farrar induce me to speak. When Schauta was nearly 65 years of age he was asked by the Glasgow Obstetrical Society to write a paper on contracted pelves. His paper was based on 80,000 cases of obstetrics. It was one of my duties to teach him how to deliver that paper and naturally I learned by heart what his conclusions were, and there has not been a word uttered today, until Dr. Goodall expressed his opinions which conformed to what Schauta considered a test of labor. Schauta's conclusions were that the test began not with the onset of labor pains, was not determined by any number of hours, but really started only with the completion of the first stage of labor.

I hate to disagree with Dr. Bailey in anything but I decry the fixing of twelve hours or any other number of hours as a test of labor. After the cervix is completely dilated a test of labor of eight hours is usually sufficient.

DR. HAROLD BAILEY, (closing).—I cannot attempt to answer all the questions and problems that have been brought up, but it seems to me that everyone who has spoken on the subject has taken a different angle.

Of course, the main point in the discussion is the number of hours for a trial labor, and the lack of knowledge, on our part, of the dilatation of the cervix, or perhaps even of the rupture of the membranes. You will recall that I said *twelve hours* of *strong pains*. This is quite different from primary inertia and the actual result in the average of these 37 cases, is a trial labor of 23 hours, or if we cut out three cases that were not under our control throughout the labor, the average was 17 hours. I think that emphasis on the term *strong pains* will satisfy everyone.

I believe that the vaginal examination is harmful. We are now using mercurochrome in the vagina and I believe the examinations will be followed by less morbidity.

Another point that has been mentioned is the difficulty of this particular type of cesarean section. I know that the time required is longer and I think it is a little more difficult.

At Bellevue Hospital we take all the operative cases from the two outdoor services so that the incidence of cesarean section should be rather high. We have an incidence of 1.7 per cent.

In breech presentation in contracted pelves we do not permit trial labor. If we cannot turn the baby so that the head presents, we know that the removal of the aftercoming head will give a very high mortality for the child and therefore we do an elective section. We never take x-ray measurements; we know by looking at the woman what type of pelvis she has. We have never known it to fail that in the examination of Michaelis' rhomboid in a flat pelvis, the depression below the last lumbar vertebra drops so that it forms a triangle and not a rhomboid.

I wish to apologize to Dr. Stone who presented me with a Peret pelvimeter, because I was absolutely unsuccessful with it. I feel the size of the child with my hands and I consider this a better method of estimating whether or not the head will go through.

DR. HERBERT THOMS, New Haven, Conn., (by invitation) read a paper on **The Clinical Significance of X-Ray Pelvimetry.** (For original article see page 543.)

DISCUSSION

DR. L. A. CALKINS, UNIVERSITY, VA., (by invitation).—I would like to ask Dr. Thoms whether he recommends this procedure as a routine measure, or reserves it for those cases in which he finds some degree of contraction, and how accurate he considers this method to be. Internal measurements of the superior strait obtained either by pelvimetry or by hand are supposed to be accurate to five millimeters or thereabouts. To be of any value the x-ray method must give the dimensions accurately to a greater degree than five millimeters.

I agree with Dr. Stone that it is essential to know more about the size of the passenger.

I had two cases recently in negro women both with moderately contracted pelves. On the one with a "very large" baby we did a cesarean section and obtained an 11½ pound baby; the other we allowed to go through labor and obtained a 9 pound baby through the birth canal.

DR. ALFRED B. SPALDING, SAN FRANCISCO, CALIF.—I will show some slides to demonstrate the method we use at Stanford to measure the pelvis by x-ray. This method was developed some years ago by Chamberlain and Newall and we have been using it for six or seven years with considerable satisfaction. A plumb bob is hung below the x-ray tube and two pictures are taken, using a 10 cm. shift of the x-ray tube between pictures. With these pictures in a stereoscopic viewing box, ink marks are made so as to correspond, stereoscopically, with the promontory, top of symphysis and all other points from which measurements are desired. The obstetrician should consult the plates to assure himself that these ink marks are correctly placed because it is in the placing of these points that the accuracy or inaccuracy of the method lies. The x-ray man can determine accurately the distance between any two points in the pelvis if we pick out the points.

Dr. Newall has developed a mathematical ruler to measure the distance between these points.

We have taken several hundred of these measurements and the point I wish to emphasize is that x-ray measurements are more accurate than the clinician's measurements with the pelvimeter. The x-ray gives somewhat larger measurements than are obtained with pelvimeters due to the fact that they are bone measurements and we must take allowance for that clinically. That is particularly true in the outlet measurements.

We should use in obstetric work the x-ray department more than we do. Many unexpected by-products are obtained in x-ray measurements. For instance, here is the original picture, that established the fact that it is possible to note the death of the baby by the shrinkage of the cranial contents.

DR. RUDOLPH W. HOLMES, CHICAGO, ILL.—This paper is a landmark in x-ray work in relation to obstetrics, however, I regret that Dr. Thoms has completed only half of the picture. He has given us a new and valuable means of determining the pelvic size and configuration, but the other half of the picture is wanting—the size of the fetal head in relation to the pelvis. I trust he will be able to depict and measure both pelvis and head in one x-ray picture. I have used the x-ray for years in the determination of the cephalo-pelvic relationship: I feel we have some criteria by the study of the amount of "corona" between the head and pelvic brim. I thoroughly appreciate that the head being nearer the tube—and the pelvis nearer the plate—there will be distortion but this interpretation of the corona has its due value.

DR. IRVING STEIN, CHICAGO, ILL.—In the last five years we have studied over 730 obstetric cases roentgenographically. We feel that the clinical data are of far greater importance than the x-ray data. A little deflection of the head, a little posterior rotation of the occiput, are of more significance clinically than are x-ray measurements of either the head or the pelvis.

The lateral pictures that Dr. Thoms showed are of exceedingly great value. I think we thus learn a great deal more about the sacrum and its form than we can ascertain by palpation; we have come to use the lateral posterior more frequently than formerly.

I disagree with Dr. Holmes concerning the corona. If the patient is radiographed in antero-posterior the head shadow will be exaggerated so as to apparently completely overlap the pelvis. A film taken in the postero-anterior will show less distortion. You can learn more by palpation and trying to force the head in from above than you can tell from the roentgenogram in these cases. The difference in the size of the fetus on the film in the two views described is often great; in the prone posture the fetus being nearer the film will give you a more accurate fetal shadow as to size whereas in the dorsal posture it will vary according to the size of the patient and the distance of the fetus from the film.

DR. HERBERT THOMS, (closing).—Of course, I agree that in the individual case the best pelvimeter is the baby's head, but I also believe that this x-ray method has its value not only for exact mensuration of certain dimensions but certainly also for the classification of contracted pelves. I do feel that it is accurate to one or two millimeters. That has been our experience in checking the method up. As a routine method I do not recommend or use it. It is simply for the case in which it is felt that more accurate knowledge of the superior strait is wanted. Lateral pictures are a great aid, particularly in the diagnosis of rickets.

DR. LILIAN K. P. FARRAR, New York City, presented a paper on **The Reaction of the Tissues to Radium in Treatment of Cancer of the Cervix, and the Importance of Lacerations in Producing Cancer in This Location.**

Abstract

In the Woman's Hospital in the State of New York, all ward cases of cancer of the cervix who have been treated with radium return for inspection once each month over a period of five years or longer if they can be persuaded to do so. The reaction in the cervix to radium treatment is so nearly uniform that we believe we know what the appearance of the cervix will be each month if the case is progressing favorably; and that we can tell when the expected effect of radium has not been reached and a subsequent dose is needed. In order that we might fully appreciate the changes taking place in the cervix after irradiation the medical artist has attended the follow-up clinic each week and made a series of sketches in water color of individual cases beginning before the patient has received radium treatment and then sketching the cervix at each successive visit to the clinic. The visits to the clinic are sufficiently far apart to show definite stages in the progress made by radium treatment.

I. A Stage of Hyperemia.

One week after the initial dose of radium has been given the tissues of the cervix, including of course the carcinoma and the adjacent mucosa of the vagina, are intensely red and hyperemic. The blood vessels are engorged with blood and it is for this reason that we do not consider that a case should be radiated if an immediate operation is imperative.

II. A Stage of Slough.

One month after irradiation the cervix usually shows an extensive green slough and a foul discharge is now present. We believe that this slough must have entirely separated from the cervix before an hysterectomy can be performed without great danger of peritonitis resulting from cutting into this necrotic tissue. Cases occasionally come to the clinic a month after leaving the hospital and there is no appearance clinically of a slough nor of carcinoma, the cervix having healed more rapidly than the average case, while in others a slough may be present on the visit two months after leaving the hospital or possibly, though this is rare in favorable cases, a part of the slough may still be present on the following visit.

III. A Stage of Healing.

We usually find the third stage, which is that of healing, is reached two months after radiation. The slough has separated leaving a smooth, clean, dusky red cervix which may be somewhat glazed but has clinically no look of carcinoma.

IV. A Stage of Contraction.

The following month should show the fourth stage which is contraction. Large carcinomatous growths or even craters are contracted by the irradiation to a normal or smaller than normal sized cervix and the vault is as narrow as in senile vaginitis.

The selective and also destructive action that radium exercises upon cancer cells either destroys outright or stuns some of the cells but it is to the stimulating to growth of new connective tissue that we look for the inhibiting action of radium on cancer.

V. The Stage of Marked Contraction.

Later visits show the fifth or final stage which is marked contraction. The increasing amount of connective tissue squeezes the tissues of the cervix until it is finally so shrunken that we are often asked if the cervix has been amputated. It is not until this stage has been reached that we are satisfied with the reaction of the cervix to radium. On the road to this goal we find at times that progress seems to have stopped and a second dose of radium is needed but usually the dose is less than the first and frequently only one or two needles of radium are necessary to check a nodule budding out in the cervix or vaginal vault.

It happens not infrequently when the cervix is small and shrunken and the internal os is tightly closed that the patient who has been making favorable progress up to this time, now appears in the clinic looking pale, perhaps septic and complains of abdominal pain or uterine cramp that even morphine has not relieved. A dilatation of the cervix is almost always followed by a gush of purulent or bloody fluid from the body of the uterus with immediate relief and improvement in the general health of the patient. This treatment may have to be repeated once or twice especially in young women who are in the age to have menstruation.

We have been impressed by the frequency with which lacerations were present in the cervix, and decided to study 300 of our consecutive case histories of cancer of the cervix to determine the incidence of pregnancy in this series of cases. In 288 of the 300 cases or 96 per cent, pregnancy (i.e. children or miscarriages) had occurred, leaving only 12 cases or 4 per cent who had never been pregnant.

It seems thus that repeated traumatization by labor or miscarriage might be a factor in changes terminating in carcinoma. Mention was made in nearly all the histories of hard labors or instrumental deliveries, and the specific statement was frequently met that the patient had been "badly torn" and "not repaired." In only nine instances in the 288 cases that had borne children was it recorded that "lacerations" were repaired and in six cases the repair had been made after the first delivery and no repair noted as having been made after the birth of the

next child. *In no instance was it specifically stated that the "repair" of laceration mentioned meant that the cervix itself was repaired.*

In more than one tenth of the series of 300 cases, cancer of the cervix had occurred less than five years after the last pregnancy, and in more than one fifth of the series cancer had occurred less than ten years after the last pregnancy.

The result of severe or repeated injuries in the cervical canal may be seen in the erosion or eversion of the lips of the cervix and in the cystic changes which take place in the glands themselves. Similar changes in the tissues elsewhere in the body are looked upon by pathologists as having an important bearing in the development of cancer. Should we not expect to find cancer developing in the cervix when similar conditions are present there as produce cancer in other locations? It seems only logical to ask why not repair the lacerations early? Much is being done medically in prenatal work to put the expectant mother in the best possible condition and so safeguard her for the labor, but are we giving sufficient surgical attention to postnatal conditions and especially to the injuries present after the delivery in the birth canal?

The practice of obstetrics is a surgical specialty and the obstetrician is or should be a skillful operator. The European "Frauen-Klinik" combines two specialties as one, and in no other way can the patient be adequately cared for than by an obstetrician who is also a gynecologist. Postnatal care of a patient should include repair of injuries to the cervix either by immediate, intermediate or secondary operation depending upon the extent of the injury, the condition of the patient, and whether the operation can be conducted with adequate assistance and aseptic technic.

With the increasing percentage of cancer of the cervix, is it not possible to lessen the menace of this terrible disease by turning back to the teachings of fifty years ago? Inspect the cervix of the recent mother and then employ a technic so simple that when performed soon after the injury has occurred it will restore the tissues to normal.

DISCUSSION

DR. C. JEFF MILLER, NEW ORLEANS, LA.—For a number of years we were uncertain as to exactly what tissue changes followed the use of radium, but our knowledge in this regard has increased, and those of us who have had a large experience with irradiation can verify the gradual changes which Dr. Farrar has emphasized. The belief is still common that the changes which follow irradiation are due to necrosis. As she has pointed out this is not true; our good results come from the changes in the vascular connective tissue. Necrosis too often means that too large amounts of the radium element have been employed, or that the screening has been at fault. Such studies as these should be of great practical value in the matter of repeated exposures. We are too prone to resort to repeated irradiations without a survey of the tissue changes which the original treatment has brought about. In the hands of the inexperienced the bad results of irradiation may often be attributed to this very fact.

I also agree with Dr. Farrar that lacerations play an important part in the production of cancer of the cervix. We have by no means written the final chapter in the story of the neglected cervical laceration with the consequent chronic infection. Prenatal care of the pregnant woman is the greatest step forward which obstetrics has taken in recent years, but it should be pointed out that postpartal care is equally important. If within three months after delivery the condition of the cervix is carefully investigated, and erosions and lacerations attended to at once, the percentage of amputations of the cervix, Sturmdorf operations and similar extensive procedures will be largely reduced. All of them are necessary to correct the terminal stages of chronic inflammation, but trachelorrhaphy, or

sometimes simple cauterization, is frequently all that is necessary in the initial stages, although such procedures are useless when hypertrophy, fibrosis or cystic degeneration of the cervix are present. There is an unfortunate belief current, among general practitioners particularly, that such repairs should not be made during the child-bearing period. That is bad advice. Prompt attention to these matters will reduce the percentage of subsequent operative procedures, and I believe also that it will reduce the incidence of cancer of the cervix.

DR. GEORGE GRAY WARD, NEW YORK CITY.—This study which Dr. Farrar has presented has been a matter of very great interest to us in the cancer work we have been doing at the Woman's Hospital. We have a follow-up clinic which we consider a very important factor in obtaining satisfactory results in radium therapy. We personally attend this clinic every week, and all cancer cases which we have irradiated return at regular intervals of one month and are closely followed up, if delinquent, with the aid of the Social Service Department. We have thus been able to trace our cases with a considerable degree of accuracy. In our series which we presented before the American Medical Association last year we had 188 out of 196 completely followed up, losing track of only 8 cases.

The idea of recording the changes occurring after radiation by color sketches originated with Dr. Farrar and I at once saw the value of this and arranged to have our artist present at the clinic every week for this purpose. The cervix is exposed through a speculum electrically lighted, and the drawings are made with colored crayon directly from the patient. These typical pictures shown by Dr. Farrar give an excellent idea of the progress of the process as we see it at regular intervals, and we find that it is a matter of about three months before we get the final result of complete healing. It has been of great value in teaching us to appreciate what we may expect from irradiation. From observing these cases in this way at stated intervals we have learned what changes we should expect in a given time, and when these do not occur, or should a recrudescence of the disease show after healing, we are on our guard as perhaps that case will need a further irradiation to produce the desired result.

Another point Dr. Farrar has stressed is the importance of the prophylactic care of women after labor, as it undoubtedly has an etiologic bearing on the cancer question. We have in our series of cases quite a number of women in the child-bearing age who have developed cancer, therefore it is important that we should see that there is no condition left after a labor that will be a possible source of irritation, as it may be a factor in starting malignancy.

We believe that immediate repair of a lacerated cervix should be given serious consideration. During the last year or two there have been several papers written advocating this procedure. Reel of Columbus and Emge of San Francisco, and several others have recently written on this very point as to the importance of the immediate repair at the time of the labor. Women are now educated so that they come to the hospital to have their babies, and therefore the majority of cases can be taken care of under ideal conditions, with ample assistance and proper facilities. We do an episiotomy on many primiparas nowadays and we do not hesitate to suture that episiotomy wound at the time of labor, and it is very easy to inspect the cervix at this time, and the placing of the required sutures is a very simple matter and it should not, it seems to me, be a cause of more danger of infection than the episiotomy wound should be. I believe the fear of infection that some of us were taught is not warranted today under proper conditions.

The importance of the postnatal clinic should be emphasized and given more attention as Dr. Farrar pointed out and as Dr. Miller has just said. In the Woman's Hospital we have a postnatal obstetric follow-up clinic. Patients come back three times after their labor, at monthly intervals. At the end of the third month they are given their final examination and discharged. A visual examination

of the cervix should be made in order that its condition may be known so that the patient may have the advantage of treatment if necessary. I think it will be a distinct step in advance, if we repair these cases immediately, as is done in some clinics. Dr. Byron Goff of the Woman's Hospital has been doing this recently on a number of his cases and I think in a short time, we will have definite results to report with regard to this matter of immediate repair.

DR. WILLIAM A. SCOTT, TORONTO, ONT.—I have been very interested in the technic of radiation as developed by Dr. Farrar and Dr. Ward since their first publication. During the last three years I have ceased to operate on endocervical cancer. I still operate on cancer of the body of the uterus and on early cancer of the vaginal portion of the cervix. Their technic has appealed to me as very excellent in that type of case where one can see the primary growth, and therefore can trace out the action of the radium. But, unfortunately, that is not always the type of case with which we are dealing. If one finds the cancer starting in the cervical canal where, at the time of observation there is no invasion of the vaginal portion of the cervix, a different problem confronts us. If we radiate a growth in the cervical canal we cannot gauge the action of the radium as has been outlined here. This means necessarily two types of technic, one for cancer that is visible through the speculum, and a different technic for cancer that is not visible. One would hesitate to underradiate a cancer arising in the cervical canal, while one might not hesitate to give a smaller dose to a cancer that one could see. Therefore, up to the present, my technic has been the same for both forms of cancer, the very heavily screened radium, so that both the primary and secondary beta rays are eradicated with a heavy dose; and then, either with or without any symptoms or palpable findings, this dose is repeated at the end of three months. That is apparently about the right time according to the observations made, but I would like to know just how they treat in the Woman's Hospital the cases with endocervical cancer which are not visible through the speculum.

DR. JOSEPH L. BAER, CHICAGO, ILL.—Does Dr. Farrar advocate the routine inspection of the cervix after every delivery? I am inclined to believe that a spontaneous first stage without premature bearing down and spontaneous second stage should leave the cervix intact. An elliptical external os after involution indicates rather a physiologic nick, so to speak, of the cervix than a trauma which might lead to carcinoma later on. In cases that have run an entirely uneventful course, are the lesions ever sufficiently gross to make it necessary to reconstruct that cervix surgically?

DR. EDWARD A. SCHUMANN, PHILADELPHIA, PA.—I confess that I was surprised at the emphasis laid by Dr. Farrar upon the immediate repair of the cervix since we in the provinces have been taught to inspect routinely every parturient cervix and repair all lacerations immediately after labor just as we repair the lacerations of the perineum. In a very large number of easy, spontaneous deliveries there will be found considerable laceration, on the side to which the occiput was inclined, and the lacerations frequently extend almost to the base of the broad ligament. If it be true that exposure and repair of the cervix is not a routine obstetric procedure, any one who institutes this technic will be surprised at the large number of lacerations occurring even in spontaneous deliveries.

DR. GEORGE W. KOSMAK, NEW YORK CITY.—Several most interesting points were brought out in this paper. The main one, I think, is the obstetrician's responsibility at the time he dismisses the patient. The postnatal clinic advocated by the speaker is a most admirable conception and it would be an excellent thing if all obstetric departments would establish them. But even this would not by any means reach all of our maternity cases. The greatest amount of neglect in maternity

cases, in labor and after labor, necessarily occurs in those women who are not clinic patients. Unfortunately many obstetricians dismiss their patients at the end of two weeks with a casual bimanual examination in which cervical lacerations are diagnosed with the finger rather than by the eye. I don't believe that the exact condition of the cervix can be determined unless a speculum is introduced and the cervix carefully inspected. The important thing, however, is such an inspection not at the end of two weeks, but after four, eight or twelve weeks. It would be a better rule to see all our maternity cases, at these intervals. Only thus lesions can be discovered that are not noticed at the time of the patient's discharge from the hospital.

In addition to the lacerations there is another class of lesions that deserve as much attention as probable precursors of chronic inflammation and malignant disease later on. I refer to polypoid degeneration and erosions. Polypoid degeneration may undergo marked exacerbation during the later months of pregnancy. I think the cervix should be inspected also during pregnancy if there is any history of discharge or irregular bleeding, and in those cases we can be on our guard to institute the proper treatment after delivery. So much has been done with the electrocautery that every obstetrician should be equipped with this device in order to treat the polypoid degenerations and erosions as soon after the first month of childbirth as possible.

DR. ALFRED B. SPALDING, San Francisco, Cal.—I would like to ask Dr. Farrar whether she has ever observed carcinoma developing in the scar of a trachelorrhaphy wound? Personally I have not seen it.

In the clinic at Stanford we have for five years had the junior internes repair the cervix following delivery. Eight days after delivery, the primiparas are inspected, and the interne repairs the torn cervix, the patient leaving the hospital on the tenth day. I believe this is a valuable teaching for the general practitioner. The trachelorrhaphy is quite superficial. I believe it prevents cervical infections and does not complicate future deliveries.

DR. C. H. DAVIS, Milwaukee, Wisconsin.—Lacerations and other trauma of the cervix undoubtedly favor the development of chronic endocervicitis and thereby lead to more or less pelvic disturbance. Chronic irritation apparently increases the frequency of cervical cancer and with Dr. Farrar I believe the prevention and cure of chronic endocervicitis of great importance. However, in our obstetric follow-up we see relatively few patients with cervical lacerations which warrant operative repair. We use the cautery frequently on patients showing slight lacerations and early endocervicitis with most satisfactory results.

Dr. Farrar states that cancer does not develop where there was not a previous trauma. I recently reported the case of a 24 year old girl who came to me because of sterility. Examination showed an intact hymen. There was no history of previous leucorrhea or of menstrual disturbance with the exception that there had been a slightly increased flow with the last two periods, and a very little discharge between. After the hymen was dilated under anesthesia it was found that she had a small early squamous cell carcinoma of the cervix. We obtained a history of a maternal aunt having died at the age of 30 from cancer of the breast; a twin sister had been operated for toxic goitre, and this girl has an adenoma of the thyroid. We must take seriously the work of Maude Slye regarding heredity in the development of cancer, for while these chronic irritations are undoubtedly important, there are other factors which we are at present unable to control.

DR. FRED L. ADAIR, Minneapolis, Minn.—It seems to me that in advocating repair of the cervix we should not lay too much stress on the fact that we find carcinoma of the cervix much more frequently in women who have borne children without recognizing the fact that the women who have borne children are much

more numerous than those who have not. As a matter of fact, there is not much difference in the incidence of cervical carcinoma in nulliparous women and parous women in proportion to their number. I think this fact should be borne in mind regarding the conclusions about repair of the cervix so far as cancer is concerned.

We are not in the habit of making immediate repairs of the cervix in Minnesota. We have fear of contamination and we certainly see some cases of infection even without invasion of the vagina and an occasional fatality. Any manipulation through the vagina certainly does not lessen the frequency of infection. I have examined a good many cervices following delivery, and postnatal work is not new with us, but I haven't seen such large numbers of bad cervices after spontaneous deliveries. We see a good many erosions but some of the worst cervices that I have ever seen were those that had primary repair. I think it is rather difficult to repair the cervix immediately after delivery because it is distorted. The anterior lip is apt to be elongated. I believe we ought to be a little careful before we advocate this as a general procedure, especially among men who are going out to practice indiscriminately in homes and in hospitals. It might be well for an expert to do that sort of thing, but I think we should be certain of our ground before we undertake to teach students such a routine procedure.

DR. WM. C. DANFORTH, EVANSTON, ILL.—I am glad to hear Dr. Farrar's remarks on inspection of the cervix after labor. I was taught differently. I was told that the cervix was not to be repaired unless hemorrhage necessitated it. We find a considerable number of tears on inspection. I believe it is true that some of them fail to heal well because the suture is not put in with due regard to the anatomy of the tear. A suture that is put in near the edge, without taking into consideration the fact that the muscular part contracts, does not give the structure the support it needs. One should therefore put in a suture deep enough to grasp the muscularis, but without constriction. If one pays attention to this point, they heal up in a very satisfactory way.

DR. N. SPROAT HEANEY, CHICAGO, ILL.—Recently I saw a case in the ward at the Presbyterian Hospital, a woman married eight years, 30 years of age, who had had five children and after each one of the deliveries she had been operated upon by a "prophylactic" surgeon and a cervical repair done. Now in eight years of married life she had had five children, been in the hospital five times on that account and five times subsequently for repair of the cervix. When I examined her she had a marked retroversion and some prolapse of the uterus.

In my mind there is a question whether she has not now more chance of becoming carcinomatous as a result of five operations on her cervix than if she had had five babies in the hands of a midwife and been just ordinarily attended to.

DR. LILIAN K. P. FARRAR (closing).—I will speak first of intracervical carcinoma. We have found frequently that intracervical carcinoma is often mistaken for an early carcinoma and it is not until we begin to dilate the cervix that we find there is an intracervical lesion. We use radium in exactly the same way as we do in the squamous cell type but place the radium a little higher in the cervix to cover the area involved and then employ the same technic in fastening the radium *in situ*.

The question of routine inspection immediately after delivery I think has already been answered by those who have been doing an immediate repair of the cervix. I have been interested in this since I began to look up the literature of cervical carcinoma.

As to the matter of hereditary carcinoma I found in reading the cancer reports in the recent survey that it is believed inheritance plays almost no part in the occurrence of carcinoma.

As to the frequency of carcinoma occurring in women who have borne children in comparison with women who have not borne children I am indebted to Dr. R. L. Dickinson for the information that 80 per cent of all women are married, and that 70 per cent of these bear children, which should make the incidence of carcinoma in married women approximately 55 per cent. The incidence however is 96 per cent in this series of 300 cases, and higher in other series reported, and probably really higher in this series, because many of the women who stated they did not have children, probably meant they did not have living children.

Now as to whether cancer has been observed in a repaired cervix and whether cancer is less likely to occur after five repairs, as in the case reported by Dr. Heaney. The presence of a tear in the cervix is frequently the cause of a one child sterility, thus the patient referred to perhaps might not have had the other four children if she had not been repaired. I have not been able to find anything in the statistics in regard to cancer occurring after a repair in the cervix but both Dr. Davis and Dr. Hirst have told me they have never seen cancer occur in a cervix that has been repaired. Dr. Davis has advocated immediate repair of the cervix for eighteen years and in reply to an inquiry wrote to me three days ago that he is still in favor of making an immediate repair of a laceration in the cervix. Dr. Hirst is still doing what he advocates—an intermediate repair.

Dr. Schumann said he had been taught to look for lacerations and to repair them at the time of labor. We have not had this teaching that he has been fortunate to have had in Philadelphia. I do not mean to imply that immediate repair of lacerations of the cervix is anything new. It is an old subject that has been up many times and discarded many times as impracticable but with more women being delivered in hospitals and more attention being paid to immediate repair of the lesions in the vagina and pelvic floor I have brought this subject up again in an effort to offset the increase of carcinoma in the cervix.

DR. FRANK A. PEMBERTON, Boston, Mass., (by invitation) read a paper on **The Relation Between the Treatment of Cancer of the Cervix and the Cell Type.** (For original article see page 536.)

DISCUSSION

DR. CAREY CULBERTSON, CHICAGO, ILL.—This is the first time so far as I know that this subject has been presented to this Society. Before the studies made by Martzloff, Pomeroy and Straus and others, it was believed that carcinoma originating in the cervical canal yielded to radium better than carcinoma in other sites. This paper explains in a large measure such belief.

The long continued spinal cell type, which we see in epitheliomas of the skin—carcinomas which really become chronic you might say, and where the patient lives for years, is not seen in the uterus. I have seen a patient in the last year whom I operated upon two years ago for procidentia. At that time she had had a carcinoma of the breast for fourteen years. She is still living. We do not see things of that sort in the uterus and we are not warranted, therefore, in giving the patient a better prognosis alone on the basis of finding a spinal cell type, rather than a transitional or a fat spindle cell or an adenocarcinoma.

DR. EMIL NOVAK, BALTIMORE, MD.—I believe that the essayist very properly emphasized the fact that the human factor, rather unfortunately, plays an important part in the scheme of classification by cell type. There are certain cancers which are definitely of the spinal cell type, and others which are just as definitely of the fat spindle cell type, but many cases will occur in which the cell type will be differently interpreted by different observers, as between the spinal cell and transitional, fat spindle cell and transitional, etc. Furthermore, it should

be emphasized that in order to draw proper conclusions one should study not one but many sections from each case, as one and the same cancer may show quite different pictures in different areas. For example, the growing margin not infrequently presents a picture quite different from that of the older and degenerating parts of the tumor. The same general statement applies to the interpretation of the proportion between stroma and cells.

In spite of these drawbacks some valuable data appear to have crystallized out of such work, particularly the fact that in the cervix, contrary to what might have been expected, the spinal cell group possesses a definitely lower grade of malignancy than the basal cell type. On other epithelial surfaces, such as the face, it is of course the basal cell type which is relatively benign. This work is in line with the work of Broders, whose studies of cancer cytology have led him to the conclusion that the higher the differentiation of the cell, the lower its relative malignancy. As the spinal cell is a highly differentiated type one is not surprised at the conclusions of Dr. Pemberton and also of Martzloff as to its lower degree of malignancy. The surprising thing is to understand why the spindle cell type is so much more malignant in certain other epithelial surfaces.

DR. FRANK W. LYNCH, San Francisco, Cal.—Quite recently I had the opportunity to review the cases treated by radium which after five years were considered cured. I was astonished to find that there were 306 cases, treated with radium, with but 40 per cent of cures.

San Francisco holds the very unenviable position of having the highest cancer rate of any city in America. Of 250 cases seen in my small clinic, 107 have now gone through the five year period, and as we follow this work we realize that radium is not the method to be featured. If radium cures only 40 per cent of operable cases and 15 per cent of inoperable cases, there must be something beyond the action of radium itself. We have not been able to come to any conclusions concerning this factor. There is an individual variation in the type of growth, and in our 107 cases we have found a very large percentage of transitionals even though we have cured 60 per cent by radical operation. Repeated sections must be taken from the cervix, because a section from one spot does not necessarily reveal the essential lesion growing there.

DR. J. HOFBAUER, Baltimore, Md.—Since the work of Doederlein's clinic has been mentioned, I should like to discuss it inasmuch as I was associated with this clinic for some time.

We likewise reached the conclusion that the histologic findings in cervical carcinoma give no clue to the prognosis. We must also bear in mind that the excision of cancer tissue for biopsy is not devoid of danger, for this procedure may favor the spread of carcinoma cells.

Doederlein frankly admitted on several occasions his disappointment with the results obtained by radium treatment, and, at my suggestion, a new method was introduced in his clinic and has been practiced as a routine for the last three years.

It is generally admitted that progress in the radium treatment of carcinoma of the cervix is possible only if we are able, first, to render more efficient the defensive mechanism of the body against the carcinoma; and second, if we can sensitize the cervical cancer and make it more susceptible to the destructive action of radium rays. This was the problem. In our studies, we found that if we applied a third of the erythema dose of x-ray to the region of the hypophysis, an increase of about a million red cells occurred in the blood. A marked increase of the eosinophilic cells and of the cholin contents of the blood was also noted. The effect of pituitary radiation on the cervical carcinoma itself was demonstrated by the study of successive excisions of pieces of the carcinoma—the first excision

being made immediately after admission, the second a week after the radiation of the hypophysis. In the second specimen the carcinoma cells are found to have undergone a marked degeneration and the connective tissue showed a definite dilatation of blood vessels and a cellular reaction as well. The stimulation of the defensive forces of the body is thus demonstrated. This is quite in harmony with the statements of Sajous that the pituitary, through the intermediary of thyroid and the adrenals, may stimulate the defensive functions of the body. The patient, having thus been prepared by the radiation of the hypophysis now receives 100 milligrams radium bromid locally applied to the cervix in the usual manner.

The results in Doederlein's clinic have been summarized by Voltz, who claims that the new method has markedly improved the final results. The same method has of late as well been used in cases of carcinoma of the uterine body. (See Münch. Med. Woch., 1925, No. 1; Klinische Woch., 1925, No. 29; Acta Radiologica, 1926; Zentralbl, f. Gynäk., 1926, No. 14.)

DR. WILLIAM P. HEALY, NEW YORK CITY.—At the Memorial Hospital we have so far been unable to regulate the radium and x-ray treatment of cancer of the cervix upon histologic findings. Dr. James Ewing at my request went over a series of my cases just within the last month, basing his findings entirely upon Roder's specifications. It was interesting to find that practically 88 per cent of our cases came into what might be called the transitional, or rather favorable group; 18 per cent of these were absolutely favorable, that is of the adult type of cell, the spindle cell that Dr. Pemberton refers to, 70 per cent were mixed transitional and spindle cell or adult type and would lean more to the nonmalignant than the highly malignant type of cell; the remaining 12 per cent were of the highly malignant, undifferentiated, embryonal cell type.

We find that the treatment of cervical cancer cannot be based in any way upon histologic findings; all that is gained is a prognostic point of view. You can say that an adult type of cell may have a better prognosis than one of the undifferentiated, embryonal type, but the treatment of the case must be, as Dr. Pemberton has said, based upon getting into the lesion the greatest total amount of radiation that you can get in safely, to bring about not only rapid regression of the primary lesion, but the proper kind of local tissue reaction. We feel that the tissue reaction is infinitely more important in the cure, or apparent cure, of the disease than the actual destructive effect of the radium on the cancer cells.

DR. FLOYD E. KEENE, PHILADELPHIA, PA.—In our clinic at the University Hospital we have been very much interested in determining whether or not the type of the predominating cell in carcinoma of the cervix might be of value from the standpoint of prognosis and I must confess that thus far we have been very much disappointed.

Doctor Kimbrough has recently reported upon 263 cases of carcinoma of the cervix that were treated over five years ago. Of this number the best immediate results were obtained in the basal cell type (58 per cent), the poorest immediate results in the transitional type (41 per cent), the best ultimate results in the prickle cell type, the poorest ultimate results in the basal cell type, while adenocarcinoma occupied the intermediate position. The higher malignancy of the basal cell type is almost entirely offset by its ready response to irradiation, thus making the final results practically the same in all.

DR. GEORGE GRAY WARD, NEW YORK CITY.—At the Woman's Hospital I had our pathologist study our cases from the viewpoint that Dr. Pemberton has presented and without knowing what the ultimate result of the radium treatment was, he finally reached the opinion that classification in accord with cell type was unsatisfactory as a prognostic factor, and that it could not be relied

upon, because the piece of tissue removed was often not sufficient to base an opinion concerning the nature of the cancer present in all parts of the cervix. In the prognosis a great many other factors have to be considered such as the patient's age, general health, stamina, etc.

DR. ALFRED B. SPALDING, SAN FRANCISCO, CAL.—I have given all cases of cancer of the cervix to the radium department for the last two years and have agreed not to operate for five years. Recently we reviewed the histopathology of over 100 of these cases and have observed some interesting facts bearing on the classification of tumor cells. Just as the essayist has said, we have observed that about 6 per cent were of the adenomatous type. The solid forms were studied according to the classification of Schottlaender and Kermauner and we found that 24 per cent were ripe, 30 per cent mid-ripe and 46 per cent unripe. Thirty-two per cent of the total showed "mixed forms," but in all of these one type of cell predominated. The unripe cancers of the cervix seem to be the most malignant type and have the greatest rate of growth so that a greater proportion when first seen will have extended to parametrium or vaginal walls. But they react better to radium treatment, and our cases of unripe tumors with disease limited to cervix have been cured. The ripe, on the other hand, although of slower growth and less malignant, seem more resistant to the effect of radium, in fact it seems as if radiation sometimes only results in accelerating the rate of growth. For this reason, we are inclined to doubt whether this type of tumor, when limited to the cervix, should be radiated at all, but rather be treated solely by radical operation.

DR. FRANK A. PEMBERTON (closing).—I agree with the speakers that it is difficult to classify these different types of cells. We also feel that the transitional group is the dumping ground for the others.

What I wanted to bring out especially was that the dosage should not be varied according to the type of cell, but that the patient should get the full dose every time. I believe this gross classification is the one that has been adopted by the American College of Surgeons.

DR. W. A. SCOTT, Toronto, Ont., read a paper on **The Present Status of the Induction of Labor by Means of Pituitary Extract.** (For original article see page 571.)

DISCUSSION

DR. JOHN O. POLAK, BROOKLYN, N. Y.—The red flag of danger should be put up against pituitary extract. A fetal mortality of thirteen in 198 inductions is something that must be considered. When should we induce labor? When are we justified in doing it in the light of a 6 to 7 per cent fetal mortality, when we can get a 2.1 per cent mortality or less in our general obstetric practice by intelligent expectancy? There is in my opinion no place for induction of labor in contracted pelvis. The overgrown child is made a good deal of, and yet we all know that many of them will pass through, and those that will not, will come out better by section. Therefore, I want to enter my voice against any plan of induction of labor because all methods of induction of labor carry with them a greater morbidity and an occasional mortality.

DR. W. A. SCOTT (closing).—The point that Dr. Polak made is the point that I tried to cover in the first paragraph. The indications for induction were not considered in my questionnaire. They vary greatly but, as I pointed out, there is no question at all that if the general medical public feels that they have a method that is easy of technic and safe for both mother and child, many more inductions

will be done than if they feel that the method of inducing labor is not easy and that it does carry with it some danger. Therefore, I think that warning is very well given. I do feel, however, that one should not indiscriminately refuse to induce labor. If the condition that is existing in a given patient carries with it a greater danger than the induction of labor, then I feel that induction of labor is indicated and in my own practice I do attempt to follow that principle. It is, therefore, only an error of judgment if I induce labor too frequently.

DR. E. L. KING, New Orleans, La., (by invitation) presented **A Preliminary Report on Liver Function Tests in the Toxemias of Pregnancy.** (For original article see page 577.)

DISCUSSION

DR. OTTO H. SCHWARZ, ST. LOUIS, MO. (By invitation).—Dr. King has selected the two tests for liver function, or at least for some phase of liver function, which have been recently reported by several authorities to be the most valuable. Carl Greene of the Mayo Foundation and his coworkers have come to the conclusion that the phenoltetrachlorphthalein test and the Van den Burgh test are the most valuable. The former was first used by Rosenthal. He has recently substituted bromsulphalein, the dye which Dr. King has used.

In the study of Greene and his coworkers, which involves chiefly cases of jaundice, due both to benign and malignant causes, the dye test and the Van den Burgh test ran parallel as indicating the degree of impaired function. Interesting in Dr. King's work is the fact that he has found the Van den Burgh test negative in cases of preeclampsia and eclampsia, in which the liver involvement would be expected to be chiefly in the periphery of the lobule; the dye test showed impairment here. In cases of early toxemia, in cases of severe vomiting, in which the central portion of the lobule is involved, both tests ran parallel.

Our own experience with these tests has been limited to the phenoltetrachlorphthalein test. In the main, our findings agree very well with the results of Dr. King. I have recently consulted Dr. Dieckmann, who has been carrying out this work, and he feels at present, that at least in early pregnancy the test runs parallel to the glycogen content of the liver. If we have a liver with marked fatty infiltration the test will show a marked impairment. By the ingestion of large amounts of carbohydrates the fatty infiltration usually promptly disappears and the liver function test approaches the normal. Dieckmann feels that in this way one can watch the early toxemias of pregnancy, clinical improvement running parallel to the degree of impaired liver function as indicated by the test. We have had several cases in which the test has proved unusually interesting. In one instance it was negative in a very severe case of nephritic toxemia in early pregnancy. The patient had a marked hypertension and a large amount of albumin in the urine. She was well known as a nephritic before her pregnancy. In another case, a fatal case of eclampsia with convulsions in which the liver at autopsy showed a marked lesion, there was absolutely no retention of the dye.

DR. EDMUND B. PIPER, PHILADELPHIA, PA.—I am glad to learn that Dr. King has much the same feeling about these tests that I have had and Dr. Schwarz has, that is, they are not absolutely paramount. Such a test unquestionably has its value and its place, as I see it, in the cases of hyperemesis gravidarum. Possibly it would help us to know the time when to terminate pregnancy, if it is necessary. I don't believe that laboratory tests will ever clearly designate what we should do in the treatment of eclampsia or the preeclamptic state. To best illustrate that, take the type of case I have always been taught to look upon as the liver type of toxemia, or the low pressure type in which there is no rise of

blood pressure, very little if any albumin and not many of the clinical symptoms. I remember one case well which was seen in the out-patient department of my dispensary at the Philadelphia Lying-In Hospital, in which our records showed that within three days she had a blood pressure of 115, practically no albumin and no symptoms. She came to the Hospital at midnight, complained of nothing except that she thought she was in labor. She was not progressing rapidly and was allowed to go back home. She returned at 3 o'clock definitely in labor. At 7 o'clock she had a convulsion and was dead in an hour and a half. What liver function test could control a case of that character?

All studies in liver or kidney function tests may be of great value, but we must not forget the clinical picture that goes with it.

DR. J. HOFBAUER, BALTIMORE, MD.—The signal importance of liver changes in the toxemias of pregnancy was first emphasized in my monograph on the "Toxicoses," and I was able to adduce evidence that in hyperemesis we have to deal with glycogen deficiency of the liver and of the placenta as well. Based on the severe disturbance of the carbohydrate metabolism, a functional liver test by the use of levulose was suggested. I still maintain that appearance of levulose in the urine after the oral administration of 40 grams of levulose indicates an ominous damage of the liver. As to the experimental production of liver changes closely resembling the changes encountered in cases of pernicious vomiting, I refer to a paper recently read before the New York Obstetrical Society.*

Another valuable liver test, based on the same principle as the levulose test, consists in the persistence for more than three hours of hyperglycemia after the oral administration of 20 grams of glucose.

An exceedingly high level of bilirubin in the blood is characteristic of severe cases of eclampsia.

DR. JOSEPH L. BAER, CHICAGO, ILL.—We have all been taught to regard eclampsia as either nephritic or hepatic in origin. We have all tried to treat eclampsia by prevention rather than by cure if possible. The urologists and the internists have recently been urging the value of two renal function tests which may be correlated with the hepatic function tests in this discussion. They claim for them a delicacy far beyond anything brought out heretofore for renal function. If it is true that these tests reveal renal dysfunction in women, apparently well, then the hypothesis which I advanced before the Chicago Gynecological Society this spring might be worth considering, namely: "*that the woman does not become nephritic because she is an eclamptic, but becomes an eclamptic because she is already a nephritic.*"

DR. E. L. KING, (closing).—There are one or two other points that I want to mention that I did not put in the paper because they were not really germane to the subject. We have found in eclampsia the uric acid of the blood being high. The sickest patient that I had, showed a blood uric acid of 11.4. She had 15 convulsions, a blood pressure of 200, temperature of 106° and anuria. She recovered. We have found that the uric acid in the blood corresponds roughly to the intensity of the toxemia.

There is one danger that has been mentioned in regard to the use of these compounds in testing liver function, and that is that they may break down in the liver and give rise to the corresponding halogen acids.

Another point to stress is that there must be considerable liver damage before these tests show any reading.

Dr. Piper mentioned the annoyance of multiple puncture of the veins. We work it in this way: When we proceed to make these tests we make one puncture with

*See this Journal, issue of August, 1926.

the needle, taking out the blood for the Wassermann, for the blood chemistry and for the Van den Burgh test, and give through the same needle the Rosenthal dye. Another puncture is made ½ hour later to get the serum for the Rosenthal test. So we only make two punctures for the various tests. If positive, we will repeat the Rosenthal test in two or three days, but not oftener than that.

I believe the test will be of value in two ways: first, in helping to determine for or against the induction of abortion in cases of hyperemesis. Then, secondly, it will be of value in assisting us to differentiate between preeclamptic and nephritic toxemias. I believe we can be more conservative in inducing labor in nephritic toxemia so if we can differentiate, we can wait a little while in the nephritic type, whereas it would be dangerous to wait in a case of the preeclamptic type.

DR. R. R. HUGGINS, Pittsburgh, Pa., read a paper entitled **Ligation of Pelvic Veins in Thrombophlebitis.** (For original article see page 562.)

DISCUSSION

DR. N. SPROAT HEANEY, CHICAGO, ILL.—May I ask Dr. Huggins if he will describe to us a typical hypothetical case in which he would feel that a ligation of the thrombosed vessels would be indicated, because I fear otherwise the discussion will go afield. For my part I would like to have the discussion limited as much as possible to the type of case for which Dr. Huggins would advise operation. I would like to ask before the discussion of the paper whether he ligated the vena cava, or was that a misstatement?

DR. R. R. HUGGINS.—I am very sorry that my paper is not clearer. This is the kind of a case that I am talking about: A patient is seen four or five days after the onset of temperature. There is a history of one or more chills, a fall of temperature to 99° followed by rise to 104° to 105° and even as high as 106°, recurring day after day with an absence of any causative findings in the pelvis in the nature of an extensive infection within the broad ligaments secondary, of course, to a spreading lymphangitis, and absence of positive blood culture findings under ordinary methods. The last case reported was operated upon by my associate, Dr. Cashman. In this case, the pus in the vein contained a pure culture of the colon bacillus. Generally, blood cultures are negative and this is one of the strongest points in the differential diagnosis. With such a patient, the symptoms going on from day to day, without signs of improvement but apparent evidence that the patient is slipping, operation under these circumstances is in my opinion justified.

The vena cava was ligated in one of the bad cases. The patient lived for two weeks without any more swelling than she had before the operation, because the common iliacs were both plugged with clots. The complete plugging of the veins was in this instance equivalent to ligation.

DR. O. PAUL HUMPSTONE, BROOKLYN, N. Y. (By invitation).—Dr. Huggins has for years persistently urged the availability of this treatment for pelvic thrombophlebitis. Possibly the syndrome which he has just described may solve the point upon which this procedure has hung for many years; namely that the indications for surgical intervention are so difficult to determine that the results of operative treatment are no better than nonoperative treatment. However if I understand him correctly, the mortality in his cases is just about the same as it has been.

May I just cite some factors which make this treatment illogical, in my opinion: first, the multiplicity of the veins out of the pelvis. The only place where this surgical procedure has been successfully applied is where there is only a single emissary vein. We believe that there are occasional hematogenous infections of

these veins in the pelvis from distant focal infection. We believe the greatest advance in the management of this condition in the last ten years to be in prophylactic treatment, first by primary repair of all cervical injuries; and if we put a little mercurochrome in there, we believe the danger of infection is further diminished. Second, by the adoption of the principle of a continued complete contraction of the uterus after labor. Infections of thrombi in the sinuses are very much less likely to pass out through the veins of the uterine wall if the uterus is kept firmly contracted.

In Brooklyn we have had considerable success by treating these cases with small repeated transfusions; direct transfusions of not over 250 c.c. about every four or five days with a very carefully matched and typed patient.

DR. JOSEPH BRETTAUER, NEW YORK CITY.—Dr. Humpstone has expressed my sentiments only in part; he has tried to make it appear an easy problem to diagnose this pathologic condition, but I must confess that my experience has taught me the contrary.

The patient who died with an abscess in the pelvis is not a case for discussion here.

I believe that those of you who are engaged in special work in the big centers, will agree with me that the occurrence of this condition has decreased decidedly in the past fifteen years, and even without the hospital records at hand, I can state definitely that it has become rather rare. Twenty-five or thirty years ago, we saw a great many cases in New York City.

I operated upon my first case in 1909, and went at it hesitatingly. It was one of those very bad cases, exactly like the one shown on the screen a moment ago. An incision was made and both ovarian veins were found filled with blood; I ligated and cut through with the cautery; there was no sign of a thrombus. The patient had no chill for thirty-six hours, but died after five days; at autopsy the vena cava was found filled with pus. There was a small lateral thrombus which did not entirely obstruct the lumen, but there was practically no fluid blood up to the diaphragm.

Of course, you may say that the process started in the pelvis, and that we were weeks too late in our attempt to cure the patient by operation; I have operated since, however, and at autopsy have seen this very type of case with perfectly free ovarian veins, and without thrombi in the pelvic veins. If nothing can be felt in the pelvis and if the blood culture is negative, an exploratory incision is an entirely different proposition. An abscess which could not be detected by bimanual examination, may be found in any of the internal genital organs, and be the cause of the condition.

DR. REUBEN PETERSON, ANN ARBOR, MICH.—In the early nineties I thought I had solved the problem of puerperal infection by early removal of the uterus. I performed the operation a number of times but with indifferent success. The trouble was that my reasoning was wrong in that I was dealing with a blood stream infection which was affected very little, if any, by removal of the uterus.

I am afraid Dr. Huggins' suggestion of tying off the pelvic veins for puerperal infection is also based upon pathology equally wrong. It is what we would like to do, treat these cases surgically, if we could be convinced that it would do any good. As Dr. Humpstone has said, there are many infected veins in these cases and it would be difficult to decide which veins to tie. The main argument against the procedure is, in my opinion, that we are dealing with a blood stream infection when the damage has been done and tying of veins would do very little, if any good and probably would do harm to a patient already badly handicapped by severe infection.

DR. OTTO H. SCHWARZ, ST. LOUIS, MO.—I know of no phase of puerperal infection in which accurate bacteriology is so important as in severe cases of thrombophlebitis. Although anaerobic streptococci were isolated as early as 1895, it was not until the work of Schottmueller in 1910 that these organisms were considered as playing an important part in the etiology of puerperal infection. These organisms are particularly apt to cause thrombophlebitis. They have the property of subsequently dissolving the thrombi, small particles breaking away which give rise to the spread of the infection, involving particularly the lungs.

Schottmueller has reported many cases. He has also attempted ligation, feeling that to get any sort of results it is necessary to ligate the internal iliac veins on both sides, as well as the ovarian veins. His results have not been sufficiently good to advocate the operation to any great extent. He emphasizes that if ligation is to be successful it must be done early, that is, not longer than two weeks after the onset of the disease. It seems to me that this is a point which gives rise to the greatest difficulty, because a good many cases if left alone will clear up spontaneously, and those which are ligated late in the disease give very poor results.

We have been growing our bacteriologic cultures both under anaerobic and aerobic conditions. We have had three interesting cases of blood stream infection in which anaerobic streptococci were recovered from both the uterus and the blood stream. These cases we had hoped to cure by repeated transfusions. They all developed lung lesions. One of these cases recovered and two died from pulmonary complications in spite of numerous transfusions.

The indication for ligation, in my mind, would exist only in those cases which are definitely due to anaerobic streptococci and not due to the ordinary pyogenic organisms; and secondly, that ligation be performed only in those cases at such a time when the lung lesions make their appearance, in the hope of preventing further dissemination of thrombotic particles, and by good supportive treatment in addition give the patient a chance to combat the infection as it exists at that time.

DR. JOHN O. POLAK, BROOKLYN, N. Y.—There is one correction I would like to make in regard to the cause of thrombophlebitis. My impression is that it originates in the placental site and that the relaxed uterus with a vaginal flora represents the etiology in a very large number of cases.

In regard to the point that Dr. Huggins has so well brought out, I am frank to say that he has not made it one bit clearer to me *when I should operate.* I have operated under just the indications that he has, and have had a mortality higher than when we did not operate.

I have once in a while, probably once in two or three years, yielded to the temptation of doing surgery in these puerperal cases, and then my pathologist and I go over the material and are surprised to see how I have disseminated the infection through the barriers that nature has put up.

DR. EDMUND B. PIPER, PHILADELPHIA, PA.—I want to ask Dr. Huggins if he has ever asked these patients if they had a pain in that side for six of eight weeks previous to confinement? I have found in some cases where a lesion developed on one side, that there was a pain on that side previous to confinement, and there might have been a focus of infection in the general organism before this one lit up.

I believe that multiple incisions, or any incision, where there is no pus, may change a condition which is taken care of by the lymphatics into a blood stream infection. Some of the gentlemen who have discussed this paper have apparently gone on the hypothesis that there was blood stream involvement in the cases that Dr. Huggins spoke of. I thought he was speaking of the cases that had definitely no blood stream infection. When ligation is done the veins must be opened and thus you will enhance the chances for a blood stream infection.

DR. C. JEFF MILLER, NEW ORLEANS, LA.—In 1917 I made a collection of all the material on this subject reported in the literature, and even secured the autopsy reports in detail to see just how far we were justified in performing this operation. I had had one or two very dramatic results from ligation of the veins, and I thought the study might be of value. When I had collected all the reports and saw the variety of the veins involved, I began to be skeptical about the operation, and after I had done about five cases I became more conservative and have not done a ligation since. If the operation is done early, it is frequently unnecessary, if it is done late, it is always useless. In the cases where only one vein was involved, as the ovarian, ligation would often control the infection. When the internal iliacs were involved and ligation was done, the mortality was much higher. When ligation of the external iliacs was indicated, the recoveries were few. The series included a few cases of ligation of the vena cava, and I cannot recall that a single patient lived after the operation.

There are undoubtedly cases in which ligation of the thrombosed veins will ward off a fatal issue, but the pitfalls of diagnosis, the difficulties of deciding on the proper time for operation, and the fact that so many of these patients recover without interference make one hesitate to resort to the operation very often. Theoretically it should be done when the condition is acute, which will mean that many unnecessary operations will be performed. On the other hand, when the chronic stage is reached, the veins are often crumbling and perivenous pathology exists, so that simple ligation is not indicated. Resection of the veins, however, increases the risk to the patient and is not generally a satisfactory procedure. Pulmonary and cardiac lesions are definite contraindications.

The operation unquestionably has a definite field, but it is a very limited one, and I cannot agree with Dr. Huggins that it should be the rule in septic thrombophlebitis in the early stages.

DR. HIRAM N. VINEBERG, NEW YORK CITY.—This paper has gotten so many knocks, and as I feel that I am partly responsible for having introduced this operation in this country, I might say a few words in its defense.

I reported the first case in January, 1908, probably the first case done in this country. Then I presented a paper on this subject in 1910 to this Society. I said from the outset that the difficulty was in determining what were the indications. I am given credit for having considerable clinical sense and I may say for myself that in those cases upon which I operated the pathologic conditions of the uterus and the pelvic veins showed that the patient's chances of recovery were rather small.

Now the diagnosis of the condition is very simple. You see these excursions of up and down temperatures, chills may be present or not, and very little is to be felt in the pelvis or even through the abdominal wall. To wait until the disease reaches the vena cava and then operate, when there is a retrograde process, when the legs are swollen from the thrombosed vessels, is unwise because then the disease has passed beyond control. If there is real infection of the veins—and I have operated on cases in which the ovarian veins were as thick as my thumb—merely passing a ligature around them does not seem to be sufficient. I have always excised them, and in some cases as high up as the vena cava.

In the ten cases upon which I operated, as far as I can recall, there were six recoveries.

DR. FRANK W. LYNCH, SAN FRANCISCO, CAL.—If I understand it correctly, the essayist has only seen indications for this operation twelve times in fourteen years, which is, of course, something we should think of.

I do not think that the negative blood culture proves that there is no systemic infection.

DR. R. R. HUGGINS (closing).—Replying to Dr. Piper, I have never seen a case where there was a complaint of pain previous to confinement. This is undoubtedly a blood stream infection. The only difference between it and septicemia is that it is a milder form and is localized. These bacteria are going through the blood stream, but, as yet, we are unable to find them. The cases I report have been operated after careful study and after the exhaustion of all other methods of treatment. After a patient has been observed for 12-14 or 16 days, one should be able to calculate as to the possible outcome. It is possible, of course, that we may operate upon a patient who would recover without operation. The one point that I want to make in this paper, and apparently failed to get over, was that it was not hard to open an abdomen and look into it. In our experience, it has never shortened a patient's life, and it is not difficult to discover infected veins. If they are not infected, they should not be ligated.

A careful study of these cases will show a difference between the more serious ones, and those that are getting better for a period of days. It is not an operation for every day; it is an exceptional one, and one that should be held in abeyance and I am not especially enthusiastic about it, and am not upholding the operation in a radical way. I am merely trying to indicate that occasionally there is a case that justifies an exploratory incision and a life might be saved, otherwise lost.

DR. GEORGE GRAY WARD, NEW YORK CITY.—Will you just state how long you waited after the infection started in this series of cases?

DR. HUGGINS.—I have here a report of twelve cases. Four of these patients died and eight got better, but they were all desperately sick. They were not mild cases that I operated upon. The cases that died had gone from four to eight weeks. The ones that recovered were operated upon within eighteen days.

DR. ROBERT T. FRANK, New York City, read a paper on **Function of the Ovary.** (For original article see page 585.)

DISCUSSION

DR. M. A. GOLDBERGER, NEW YORK CITY (By invitation).—After the development of our technic we studied 54 specimens of blood in that number of women with regular menstrual dates. Results of these studies are as follows: Of the venous blood obtained on the first day of the menstruation, 3 cases were positive; on the second day of the menstruation, one case negative; on the third day, one case was positive. One and two days before the menstruation there were 7 cases and all were positive; 3 to 6 days before menstruation there were 9 cases, 6 were positive and 3 were negative; 11 to 15 days before the menstruation there were 11 cases, one positive and 10 negative; 16 days or more before the menses there were 13 cases, and all were negative.

In some of these cases we were able to follow our patients through one or two menstrual periods and in those instances it was particularly evident that there was a gradual increase in the hormone from the tenth day before menstruation until the first day of the menstruation; and there was a period from the second day of the menstruation to within ten days before the next expected period in which there either was none or not a sufficient quantity of hormone to be determined by our present methods.

In the cases of pregnancy we had difficulty due to faulty technic. For that reason our results are not so striking as they should be. However, with the perfection of the technic we feel that the results will be more concordant. Results of the studies in pregnancy cases are: 6 to 8 weeks pregnant, there were 9 with 4 positive; 2 to 4 months pregnant, there were 5 cases, 1 positive and 4 negative; 4 to 6 months pregnant, there were 6, 5 positive and 1 negative.

Tentatively, we feel that in all cases of pregnancy we will be able to obtain more positive results. Our later cases all gave positive results.

It is rather difficult to obtain menstrual blood, especially on the first day of flow. For this reason the number of cases is small, but in only one instance did we fail to observe a positive reaction. Of course, of menstrual blood we never obtained the large amount which could be procured from veins. In cases of menorrhagia and metrorrhagia, both in the venous and uterine bloods, we have rarely ascertained the hormone. The only exception was a young girl who was admitted for puberty bleeding, having bled for several weeks. Her menstrual blood gave a very strong positive reaction. Whether this signifies that ovulation occurs during this period of bleeding we are not yet able to state.

DR. JOSEPH BRETTAUER, NEW YORK CITY.—I wish to congratulate Dr. Frank upon his results, and the Society upon the fact that this important work has come from among its members. Dr. Frank's warning as to the serious aspect connected with the use of certain preparations in our work, should receive our earnest attention.

DR. EMIL NOVAK, BALTIMORE, MD.—The essayist's general conclusion, that the female sex hormone is to be found not only in the follicle but also in the corpus luteum and placenta, and that these structures are therefore to be grouped together as a "gestational gland," is rather confusing to those of us who are chiefly concerned with the human aspects of the problem. It should not be forgotten that there are certain very important differences between the sexual cycle of most of the lower animals and that of the woman, and there is a good deal of evidence to indicate that in the woman the corpus luteum plays a much more important part in the cycle than it does in the lower animal. In the latter, on the other hand, the follicle may be relatively more important. There are, in the human body, many examples of synergistic actions of various ductless glands but certainly we are not justified in grouping such synergistic structures as one and the same organ.

While it is true that from a developmental standpoint the corpus luteum is simply an elaboration of the growing follicle, there seems little doubt that it acquires certain characteristics and functions which are not possessed by the follicle. Again, the endometrial changes apparently associated with follicle activity are not in any way to be compared to those which are apparently associated with the stage of full maturity of the corpus luteum. The latter are characterized, not only by an increase in the hypertrophic changes in the endometrium but by a totally new picture, that of secretory activity. If, in the human being, the mature follicle is removed, the next menstruation is apt to be skipped. If, on the other hand, the corpus luteum be removed a few days before the expected date of menstruation it may be confidently predicted that the menstrual flow will follow, usually within a few hours of the operation, apparently as a result of the withdrawal of the protective influence of the corpus luteum upon the endometrium. Again, those who have been working with the lower animals, have been able to play the follicles against the corpora lutea in such a way as to make us feel that the functions are not by any means similar.

My own reaction from all I have been able to read and observe on this subject—and I have read all of Dr. Frank's articles—is that the physiology of menstruation of women is somewhat different from that predicted by Dr. Frank. I believe that the follicular secretion produces the earlier and more gradual hypertrophic changes in the endometrium (interval phase) but that a few days before the next flow the corpus luteum steps in and produces an entirely new picture, with marked hypertrophic changes and definite secretory changes, producing the well-known premenstrual or pregravid phase. The highest point of development in the endometrium is just before the onset of the flow, at which time something happens to check the

further development of the corpus luteum, and this something is a factor of remarkable clock-like periodicity. It seems to me that the only thing we can think of as causing this four weekly cycle is the death of the ovum, which had been given off about two weeks previously and which has a definite life span of probably two weeks. If not fertilized before it reaches the end of its trajectory, the further development of the corpus luteum is checked and all of the elaborate preparations the endometrium has made for the reception of the possibly impregnated ovum are rendered useless. It therefore dismantles itself and it is this breaking down or catabolic process, attended with bleeding, which we call menstruation.

DR. FRANK W. LYNCH, SAN FRANCISCO, CAL.—I should like to ask Dr. Frank if he can give any observations he has made with the follicle secretions of cystic ovaries, the ones we want to believe are atresic follicles; and also if he has done any work with the corpus luteum after the period of its regression.

DR. CAREY CULBERTSON, CHICAGO, ILL.—As a result of some histologic work we have been doing for three years or more, we have been able to determine one of the products from the gland cells. We have definitely shown the glycogen, but this gland produces something else in addition to the glycogen, the nature of which we have been unable to determine. Dr. Frank's report this morning would show that this sex hormone, whatever it is, is produced and is thrown off with the menstrual discharge. This tends to put a slightly different conception upon menstruation. The old idea, the prescientific idea of menstruation, was that it was a secretion; that it was the excretion from the body of some substance which it was good for the individual to get rid of, and it may be that we will have to come back to that conception of what the menstrual flow means.

I should like to ask this: In some women we have two types of menstruation, one that is better than the other, usually alternately. We have not been able to demonstrate in every instance a follicle and that brings up the old question whether menstruation depends upon a follicle in every instance or not? It has occurred to me that this work of Dr. Frank's might help to solve that problem.

DR. JOSEPH L. BAER, CHICAGO, ILL.—Those of us familiar with Oscar Frankl's investigations are acquainted with his explanation that the ovum after discharge and while passing through the fallopian tube derives its sustenance by contact with the lining of the fallopian tube and at the same time gives off into the fallopian tube, and so into the circulation, a something which maintains the life of the corpus luteum. If then the ovum disintegrates, that activating substance from the ovum no longer reaches the corpus luteum; the corpus luteum itself disintegrates, the accumulated trypsin in the distended glands of the endometrium is released, the trypsin frees the capillary blood and so menstruation occurs.

I should like to ask the Doctor, if we are to consider this female sex hormone as specific for the female, even in fetal life? How does he explain the fact that in the newborn breast engorgement occurs so preponderatingly in male children?

DR. FRANK, (closing).—Our results with the female sex hormone in pregnancy were unsatisfactory at the start because we didn't know that it is present in the blood in minor concentration in gestation before menstruation. Since we ascertained that fact we no longer get negative results.

Our work has been purely objective. The results are extremely concordant, and have enabled me to elaborate what I hope will prove a sound theory, yet I do not propose to make application of results to the human being until I know much more than I do at the present time, although we are able to distinguish two types of menorrhagia and of metrorrhagia.

Dr. Novak's interesting remarks about menstruation I am glad to hear. I do not expect that our theory will be accepted at once and without opposition. We propose to work it out in much greater detail.

In my paper I have made reference to Papanicolaou's recent work in which he found an inhibitory substance in the corpus luteum. I have had personal communication with him and although I have not convinced him as yet, I feel that we are speaking of the same substance used in different amount. His substance works by suppressing ovulation, in other words by inhibiting the maturation of the follicle. Dr. Herbert Evans of Berkeley, California, has another substance which he obtains from the pituitary gland which suppresses ovulation, by an entirely different mechanism. As a result of injecting his substance there is a tremendous increase of the theca lutein portion of the ovary. So perhaps there are two substances at work.

I am trying to present a large subject in a short outline and, therefore, am unable to deal with all its phases. By no means do I try to minimize the importance of the other glands of internal secretion. In a paper in 1917 I reported that I obtained the same response to the female sex hormone after removing the thyroid, adrenals and pancreas as when these glands were present. I have never succeeded in removing the pituitary on account of the difficult operative procedure.

I would like to call Dr. Novak's attention to a fact that I know he is familiar with. I am willing to admit that I am unable to distinguish by histologic criteria the exact point at which a pregravid and an early gravidity reaction can be differentiated; that is, whether it is going to be a fertile or non-fertile cycle. This lends evidence to my contention that these cycles at their beginning are identical.

A striking fact came to our attention the other day. A woman offered her blood for transfusion—this was two days before the expected regular menses—500 c.c. were abstracted but her menstruation failed to appear. We interpreted the postponement as due to the fact that too much female sex hormone was removed with the blood and that therefore, although the pelvic changes were well underway, the acme was not reached because of this abstraction.

Now as to my claim that the substance derived from corpus luteum and from the follicle and from the placenta are identical: that is based mainly on matters that I was not able to bring before you on account of the shortness of time. My collaborator, Dr. R. G. Gustavson, an expert chemist, has tried to purify the substance and in the purest form whether derived from follicle, corpus luteum or placenta it is indistinguishable. Pharmacologically, by three different tests, on the rabbit it produced the growth of the uterus which I am showing in the figures passed around, in the rat it changed the vaginal spread, and in the previously treated isolated rat uterus it affected the contraction rate identically no matter from where derived. I do not hesitate, therefore, as all pharmacologic and chemical tests are concordant, to state that the female sex hormone is secreted by these three glands. I shall be perfectly willing to change my mind if sufficient evidence to the contrary is offered.

As to cystic ovaries, we have had only three cases where we could try them out and with the small amount of follicle fluid at our disposal for such a test, we nevertheless believe that some of these cystic ovaries are functionless. Dr. Lynch inquired concerning the potency of the corpus luteum. I purposely left out controversial matters. The chief opponents of the view that the corpus luteum does contain the hormone have finally conceded that in the human being they find it present. I don't believe that any anatomist or physiologist will seriously consider the theory of those who believe that a primate differs from the lower vertebrates in regard to its corpus luteum. The difference in potency of the corpus luteum was a matter that bothered us for a long time, but we finally found that the follicle contains the sex hormone in great concentration. The early corpus luteum when first studied contained none that we could demonstrate. The corpus luteum contains very little in the flourishing state, but as it begins to involute it again contains more of the female sex hormone. I had devised the following explanation

even before I found the hormone in the circulating blood. As soon as follicle-rupture occurs the capillaries enter the follicle cavity; the hormone then at once enters the blood stream as rapidly as it is secreted and it appears then in great concentration in the circulating blood. As soon as the blood vessels begin to involute, the hormone begins to collect in the corpus luteum and that is the reason why different corpus luteum material has varied so much in its contents of female sex hormone. In the early stage it gets into the blood where we have demonstrated it. In the later stage it again collects in the gland for a short period. I am not ready yet to enter fully into the mechanism of excretion of the hormone through the uterine mucous membrane, and as I want to deal only with facts for which I have a distinct authentication, I cannot answer that question, nor why the mucosa exfoliates.

As to the ovary secreting an activating substance, I can only tell you that we cannot find the female sex hormone in the fetal tissues or the fluid surrounding the fetus. As to the theory of trypsin acting on the tissues, I think erepsin was mistaken for trypsin (the former being present in every tissue of the body) as I showed some years ago and published in the Transactions of this Society.

I am glad the question about the newborn breast was brought up. The male fetus shows it as well as the female. Among the photographs and drawings that I passed around were the breasts of a rabbit, from the same rabbit, the one being the immature breast, the other the breast taken in the middle of the cycle, and these same breast changes are shown. A tremendous increase in size can be brought on at will in the experimental animal. The same thing takes place in the human fetus. The breast is activated by the sex hormone given out by the placenta and, just as in the adult, when this hormonic influence is withdrawn you get secretion from this structure. As to the specificity of the female sex hormone I will simply reiterate that by chemical identification and numerous pharmacologic tests no difference can be demonstrated between the hormone obtained from follicle, corpus luteum and placenta and that no convincing evidence that substances derived from other sources, produce the specific reactions has been forthcoming.

DR. B. Z. CASHMAN, Pittsburgh, Pa., (by invitation) read a paper on **The Advantage of Cauterizing the Cervix in Hysterectomy.** (For original article see page 591.)

DISCUSSION

DR. S. A. CHALFANT, PITTSBURGH, PA.—We have been using this method for some little time, possibly not quite so long as Dr. Cashman, and have found it very satisfactory so far. The thorough cauterization of the cervix has done away with the annoying leucorrhea following a subtotal hysterectomy.

As to the liability of carcinoma in these cases, I think time only will tell. We have not seen any as yet, although we have seen two cases in ordinary subtotal hysterectomy.

DR. JOHN O. POLAK, BROOKLYN, N. Y.—Since presenting a paper some years ago on the incidence of cancer in the stump and the advantages of a panhysterectomy, we have been employing the method of coning out the cervix in order to compare our results. We do a rather more radical procedure than the Doctor has suggested because of the feeling that this cauterization of the cervix mucosa will not protect the woman from cancer. Notwithstanding the fact that most authorities say that erosion is a precursor, we believe there are portio cancers that are not preceded by erosion. Consequently we have adopted practically what Byrne did

in his procedure. We make a circular cauterization of the cervix, destroying the entire mucosa, and cone out a large part of the portio. The inversion of the vaginal mucosa is very perfect and the leucorrhea has been cured absolutely in every single case.

Our histologic studies of the effect of the cautery on the cervical tissues shows that there is an extension of the effect of heat far beyond the area of cauterization, some 2 or 3 mm. beyond the separation of the slough. If we are to believe that it is always necessary for an erosion to precede the development of a cancer then we certainly have in the cautery a substitute for complete hysterectomy.

DR. ALFRED B. SPALDING, San Francisco, Cal.—A great deal has been said about the advantages of panhysterectomy over supravaginal hysterectomy, and as to the danger of cancer developing in the cervical stump. The reason that for some years now I invariably perform panhysterectomy was not entirely this danger but the bad effect on the internal secretions caused by leaving an infected cervix. I have for some time been interested in the effect of focal infections in the pelvis on internal secretions. I believe, that the bad late results in regard to the post-menopausal changes after hysterectomy often come from leaving infected areas and that when the cervix is removed, the postoperative results are better in regard to the menopausal symptoms. I also believe that Bartholin's glands should be removed and Skene's glands cauterized at the same time. So many women who have a hysterectomy carry these focal infections. Perhaps cauterization will remove some of the infection, but it can be better removed by operation and with less danger if the operator gets in the habit of taking the uterus out completely.

DR. HARVEY B. MATTHEWS, Brooklyn, N. Y.—In reference to the extension of the heat: the heat from the electric cautery extends 3 to 5 mm. Corbus has shown that the heat from the cautery will kill most of the bacteria, particularly the gonococci, at that distance. So, in spite of what Dr. Spalding says, the heat from the cautery does destroy considerable infection from below. If you remove the cervix down to and beyond where the cautery has extended from below, it seems that you will eliminate sufficient infection not to be troubled with exudates afterwards. In certain extensive chronic pelvic inflammations what Dr. Spalding says may be perfectly true, that complete hysterectomy may be better, but certainly the ordinary endocervicitis with its consequent cellulitis can be treated by cauterization which is a time-saver and is just as complete.

DR. JAMES R. GOODALL, Montreal, Can.—I would like to ask whether Dr. Cashman and the others who have used this method have had to open the cervical canal to evacuate secretions retained owing to cicatricial contractions?

DR. JOHN A. MCGLINN, Philadelphia, Pa.—The basic proposition of this question is that undoubtedly the patient would be very much better off after operation if she did not have her cervix. There enters then the question of the risk of the removal of the cervix in comparison with the danger of the cervix left behind. Complete removal of the cervix does not protect the patient against cancer because she might develop cancer in the vaginal vault even after excision of the cervix. The cautery undoubtedly may prevent the great majority of cases of endocervicitis if done in the way that has been advocated today, and will probably cure the majority of cases of gonorrhea, but gonorrhea is not always cured by this method, neither is it always cured by the ordinary cauterization methods of Dickinson. In the presence of marked inflammatory disease the complete hysterectomy is not applicable in the majority of cases. There is too much risk for what you will attain. There is no doubt that cancer will develop in many of these cervices, but I question whether it will kill more patients than saved in operation when a cervical stump is left behind.

DR. B. Z. CASHMAN (closing).—It requires so little time to cauterize the cervix; there is no hemorrhage; and it adds but little to the operation.

In regard to the remark that carcinoma of the cervix does not depend upon erosion: we see many cases of profuse discharge coming from a normal looking cervix but whether there is an erosion or not, cervicitis is present.

Dr. McGlinn says that even with extensive cauterization he doesn't cure gonorrhea. I believe that is because there are other structures involved. If he burns them as deeply as I do and has destroyed the glands, the cervicitis is cured. Where there is no evident involvement we don't make it a routine to remove Bartholin's glands. We have had no cases where we have had to open the cervix for retained secretions, following hysterectomy.

If we are going to remove the uterus we can go to the limit, so we make sure that we cauterize deeply in order to get these glands. There are some cases where there are cysts at the periphery, and then we feel that amputation with the cautery is better than mere cauterization of the cervix.

The following papers were read in a SYMPOSIUM ON MISPLACED ENDOMETRIAL TISSUE.

A Contribution to the Study of Endometriosis, by Dr. Carl Henry Davis, and Dr. Roland S. Cron, Milwaukee, Wis. (See page 526.)

The Significance of Uterine Mucosa in the Fallopian Tube, with a Discussion of the Origin of Aberrant Endometrium, by Dr. Emil Novak, Baltimore, Md. (See page 484.)

Endometriosis of the Sac of a Right Inguinal Hernia—Associated with a Pelvic Peritoneal Endometriosis and an Endometrial Cyst of the Ovary, by Dr. John A. Sampson, Albany, N. Y. (See page 459.)

DISCUSSION

DR. JAMES R. GOODALL, MONTREAL, CANADA.—Endometriosis is a clinical entity which has been established beyond any possibility of doubt. The two questions which do arise are, first of all the origin of this tissue, and Dr. Novak has put that matter very clearly; and the second question which has not been touched upon is the end-results of these cases.

As to the origin, I don't think it will ever be possible by the study of the human anatomy to say that the overflow from the uterus and the tubes is not the cause, or that it is the cause, or that all of the tissues of this nature arise from preexisting endometrial tissue in the ovary. I do think, however, that a solution of this problem may come from a study of comparative physiology in lower animals where there is no menstrual flow and yet where by careful observation we may be able to determine in the lower animals a cause of endometriosis. That, if established, would, I think, clear up the matter once for all. Personally, after an examination of some 22,000 sections of the ovary, I feel more inclined to attribute the origin of this disease to ectopic embryonal tissue of an endometrial nature in the ovary, because after careful examination I have come to the conclusion that in about 50 per cent of human ovaries we find types of tissues that more or less closely resemble endometrial tissue. I think the great virtue of Dr. Novak's work is establishment of the fact that unless the superficial layers of this ectopic tissue are markedly developed, the stimulus supplied by the hormone does not lead to menstrual blood in this ectopic tissue. In many of my sections where I found

endometrial tissue in the ovary without any involvement in the peritoneum, some were undergoing hemorrhagic states whilst others were quiescent. There is often a direct communication, as Dr. Novak as shown, between endometrial tissue on the surface of the ovary and deep seated similar tissue, the two being connected sometimes by endometrial interstitial tissue only, at other times by interstitial and glandular structures. We find abnormal glandular tissues in the ovary in about 90 per cent of human organs. In comparative human anatomy we find that there is a great difference in different species in the amount of abnormal rests in the ovaries. In one series of animals, e. g., the pig, fetal rests are extremely uncommon, whereas in the sheep the rests are so common as to be almost as numerous as the normal graffian follicles. It is not surprising that we find so much of this ectopic tissue in the human when we consider the embryology of the ovary. I have said that the human ovary is a hodgepodge of ectopic tissue, and so it is. When we realize that the general epithelium dips down through the ovary to communicate with the central body and from there passes on to the paraovarian duets, and that this becomes a permanent structure in the male but undergoes atrophy in the female, we realize that this atrophy may be complete or incomplete, and that is the origin of all ectopic tissue in ovarian structures. Abnormal tissues in the ovary are the direct result of lack of destruction and lack of total absorption.

It is strange that in the question of endometriosis the pathologist has come so little to our assistance. I don't think it is possible, although Dr. Novak's paper is very convincing, to come to any other conclusion than that a large number of cases are really primarily ovarian in origin and that the grafts are going down the tube in the ordinary course of the current. We cannot deny that it may occur in the opposite direction in a large number of cases. I have seen blood dropping from the tubes when I opened the peritoneal cavity, but unfortunately in both of the cases I had curetted and dilated the cervix prior to opening the abdomen. I think if inflation of the tube may be a factor in driving tissue through the tube into the peritoneal cavity, the use of dilators must be a much stronger factor in driving tissue through the tubes, if such an avenue is opened. This then takes away any value that my observation may have had in demonstrating blood dripping from the tubes. I have not found blood issuing from the fimbriated end of the tube in a case where I had not previously dilated.

DR. N. SPROAT HEANEY, CHICAGO, ILL.—Since the last meeting I have had six cases of endometriosis which I think are of considerable interest. There were four cases where the abdominal wall was involved, three of them following laparotomy. One was operated upon while the patient was menstruating. There was an adenoma of the umbilicus which menstruated and that patient had not had a previous operation. Associated with the adenoma of the umbilicus existed an adenoma of the rectovaginal septum, but at operation there was no connection that I could see between these two adenomas. In one case, in early pregnancy the adenoma of the rectovaginal septum looked like a carcinoma, and there were four perforations in the vaginal vault out of which polypi hung. This case I operated through the vagina and when the nodule was excised polyps were hanging into the culdesac from similar openings on the culdesac side and one of these openings was continuous from the vagina to the peritoneal cavity. A probe introduced went on through.

Also one of the two cases of adenoma of the bladder, reported by Dr. Keene at the last meeting, has come under my observation. About 18 months ago she came to Dr. Keene for chocolate cysts and adenomyoma of the uterus. A diagnosis of adenoma of the bladder also was made previous to operation, the cystoscope showing the bluedome cyst in the bladder. Dr. Keene did a supravaginal hysterectomy with removal of both tubes and ovaries. Subsequently was observed disappearance of the adenomatous tissue from the bladder. Later on account of an

intractable cystitis she came to Dr. Kretschmer at the Presbyterian Hospital. Through the cystoscope he removed a bit of tissue for examination and it showed three typical endometrial glands. I operated upon her by the abdominal route hoping to resect the bladder. No ovarian tissue had been left by Dr. Keene. I had thought probably some ovarian tissue had escaped his attention and this accounted for the continued life of the endometrioma of the bladder. Upon opening the bladder it was found that the involvement was too extensive for removal. The bladder was involved for two-thirds of its circumference and clear down to the urethra. The abdomen was closed, a retention catheter inserted. A week or ten days later I produced a vesicovaginal fistula to relieve her of the pain. At that time I removed some pieces of infiltrated bladder wall but did not examine the sections until today with Dr. Sampson. Several slides failed to show any endometrial tissue. The patient now has a carcinoma of the bladder, of the transitional type. That there is any connection between the previous endometrioma and the present carcinoma of the bladder might be questioned.

All conservative abdominal operations are preceded by a dilatation and curettement. This probably accounts for the fact that blood dripping from the tubal opening with me is not at all an uncommon finding. We also use Hegar's dilators.

Dr. Novak has shown here within the tubes perfectly formed oval glands and a large amount of stroma, perfectly typical of normal endometrium in the uterus. I have never seen such normal endometrium in ovarian transplants or in chocolate cysts. Usually it is somewhat irregular and is generally quite scanty. The only time I have seen such normal appearance in ectopic endometrium was in the case where the polyps were hanging in the vagina and the culdesac.

DR. WILLIAM C. DANFORTH, EVANSTON, ILLINOIS.—I have on at least one occasion in operating during the menstrual period seen a small amount of blood come from the tube. Again, chocolate cysts seem always to be found in association with patent tubes. It therefore has been easier for me to accept the transplantation theory than the metaplastic one.

If the former is correct it certainly has a practical bearing on the tubal insufflation test. It would seem to place the preferable time for insufflation between the periods rather than immediately afterward, as Dr. Rubin recently suggested. I should like to know Dr. Sampson's attitude toward the insufflation test.

I have seen since the last meeting of this Society one more endometrioma in the abdominal scar seven years after a classical cesarean section. About a year after this operation a mass appeared in the scar which became painful and swollen at the menstrual period. For about one year previous to the time at which I first saw her she had had some discharge of blood from the growth at each period. There were several small bluedomed cysts upon it. The mass was removed and sections showed a considerable number of very typical nests of endometrial tissue.

DR. ROBERT T. FRANK, NEW YORK CITY.—Two very lucid and eloquent speakers have just expressed diametrically different views on the same scientific subject. I want to state that I still have an open mind because it is very possible that the Recklinghausen-Wolffian theory will hold good in certain cases; that Cullen's uterine origin from the adenomyoma in others may be correct; and that the source of origin advanced by Dr. Goodall, Dr. Novak and Dr. Sampson in certain cases may be correct, and I don't know whether we shall ever be able to arrive at an all inclusive etiology.

In 1916, at the meeting of the American Society for Cancer Research, I demonstrated the fact that if endometrial mush, made from the rabbit's uterus, is injected in the breast of the same animal a stimulation of these dissociated cells by the injection of the female sex hormone will lead to the reconstitution of endometrial structures; much as Jacobson produced in the pelvis by means of uterine

grafts. This fact would, however, not militate against the other theory, for if tissue derived from the ovaries has all the qualities of an indifferent tissue which can as it grows develop in various directions, similar results might be produced.

DR. OTTO SCHWARZ, ST. LOUIS, MO. (By invitation).—In the study of endometrial tissue in the ovary the implantation theory has impressed me for two reasons. In the first place, the surface of the ovary, which is in close proximity to the fimbriated end of the tube, is most frequently the site of the lesion; and secondly, in its earliest stages in the ovary the lesion is always very superficially placed.

There is no question that the pictures shown by Dr. Novak illustrate definite pieces of endometrium within the lumen of the tube. I believe, however, that in discussing the transit of endometrial tissue from the uterus to the peritoneal cavity one would expect to have very much smaller particles than these pictures show. I therefore believe that if this transit does take place, smaller particles get through, reach the ovary, are cultivated there, and are subsequently disseminated into the peritoneal cavity. This tissue could readily lodge on the fimbriated end of the tube and be carried within the lumen as Dr. Novak has illustrated.

I have studied a case of hematosalpinx in which the tubal mucosa simulated the endometrium, and in one place there was well developed endometrial stroma. I am under the impression that this has been rarely observed. It would seem to me that if the theory that these lesions develop primarily as a result of metaplasia of the celomic epithelium, the lesion could be expected more frequently in the tubal mucosa, because in its early development it is more closely related to the endometrium.

I have been able to demonstrate the ease with which endometrial tissue can be implanted. In an experimental study dealing with the cesarean scar in the uterus of pregnant guinea pigs, I frequently observed endometrial tissue along the line of incision in the uterus, as well as frequent implants on the peritoneal surface of this organ. These were all accidental implants but quite conspicuous.

DR. CAREY CULBERTSON, CHICAGO, ILL.—The patient of mine to whom Dr. Davis referred was complaining of sterility and a mild pelvic pain. She was given a test of tubal patency at the time and a month later. The test being positive, the patient returned later under my observation, complaining of some dysmenorrhea and mild pain in the pelvis. So far as we have been able to find out, the symptoms subsequent to insufflation test were not worse than those of which she had previously complained. At operation, performed after two weeks of observation, I found a chocolate cyst of the right ovary with an exceptionally redundant hyperplasia, endometrial in type, covering the entire floor of the pouch of Douglas, involving the anterior rectal wall and the prolapsed left tube was immersed in it. Pathologic examination showed in the chocolate cyst perfect endometrial tissue containing blood and stroma, premenstrual or practically in the active menstrual stage. This case may be accepted as possibly representing the effect of a tubal insufflation. On the other hand, the symptoms were not more marked before than after the test.

DR. ARTHUR H. CURTIS, CHICAGO, ILL.—At Dr. Sampson's suggestion, about a year and a half ago we began to observe the frequency of the dripping of menstrual blood from the open ends of the fallopian tubes. Since this time we have been operating, whenever possible, at the time of menstruation. Menstrual blood has been observed coming from the tubes in three patients. (Another typical case of retrograde menstruation was observed ten days after this discussion.)

The more one looks for these endometriosis cases, the more of them one observes. Dr. Watkins and I watched for chocolate cysts and endometrial implants, and over a period of two years observed only three cases. During the last six months I have encountered approximately fifteen patients with endometrial implants.

It is worthy of note, in consideration of the possible connection between retrograde menstruation and implantation, that in nearly all of the patients seen within the last six months there has been a retrodisplacement of the uterus; in every instance the fimbriated ends of the tubes have been patent.

DR. JAMES R. GOODALL, MONTREAL, CANADA.—I have had a large number of cases of endometriosis lately, and two of chocolate cysts. In two cases one ovary was badly necrotic, the other had a very minute excrescence on its surface. I took out the diseased one and left the other and told relatives in both instances that I had done a partial operation and might have to reopen the abdomen later for complete operation. Was I justified, or does complete isolation produce retrograde changes in this type of tissue? I would like to have an expression of opinion on that subject.

DR. CARL HENRY DAVIS (closing).—The papers today show that the etiology of this interesting condition is still a subject for investigation. We believe with Dr. Sampson that small bits of endometrial tissue may be forced through the isthmus of the tube and continue to live and grow. Until this will have been disproved we would urge great care in the performance of tubal inflation, and dilatation, and curettage.

Dr. Novak questions the viability of the endometrial tissue which is shed at the time of menstruation. It is our belief that many of the cells are living and able to reproduce themselves in proper media. We are undertaking experiments which we believe will enable us to answer this question.

DR. EMIL NOVAK (closing).—I am glad to note that Dr. Goodall also lays much stress upon abnormalities of development as possible factors in the explanation of endometriosis.

In reply to Dr. Heaney, I may say that the endometrium found in the tubes of my cases was not of the menstruating type. In other words, the factor of menstruation is probably not always concerned in the production of such wandering bits of tissue. My first case, for example, shows how readily a surface bit of endometrium on the ovary could break off by the slightest trauma, such as bimanual examination or intestinal peristalsis. It would then readily find its way into the wide open mouth of the tube. It is possible that these bits of tissue migrating through the tube may retain their viability or even undergo a certain amount of development from the tubal walls, although we cannot of course do more than speculate on this point at present. Dr. Heaney's statement that he had never observed such typical looking and well preserved endometrium in ovarian "implants" or in chocolate cysts was rather surprising, in view of the perfectly typical endometrium shown in many of Dr. Sampson's illustrations and in some of Dr. Davis' slides as well. We likewise have frequently observed in the ovary endometrial tissue which could not be distinguished from that on the uterine surface.

I agree with Dr. Danforth that Sampson's theory offers the shortest cut to the explanation of aberrant endometrial tissue, but, as I have tried to show, there are many objections to its correctness, especially as regards the occurrence and importance of tubal regurgitation of endometrium from the uterus. Dr. Sampson's case of endometriosis in a hernial sac is of interest from this standpoint. If a particle of viable endometrium did actually escape from the tube, would it sink like a stone to the bottom of a hernial sac, or would it adhere to and perhaps grow on the first peritoneum with which it came into contact? Even the influence of menstrual blood is questionable, as would appear from the case of hernia which I reported in my paper. In this case, among other things, the hernia was of the ventral type, and situated just below the navel, so that menstrual blood could scarcely have gotten into this sac. And yet, endometrial tissue was present

in abundance. Furthermore, I have seen endometrium in the vulva, evidently arising in the remains of the processus vaginalis, which had no doubt long since been shut off from the peritoneal cavity. Four such cases have recently been reported by Palmer. In such instances the theory of Sampson falls short, but the celomic theory offers a very plausible explanation.

Dr. Sampson's theory would be greatly strengthened if he could demonstrate two things, (1) the capacity of the degenerated endometrium, given off at menstruation to grow in tissue culture; (2) the capacity of such endometrium to grow on the peritoneum or ovary of the human being or perhaps even of one of the lower animals. Both of these proofs are lacking, and, because of innate difficulties, I am inclined to believe it will be difficult to prove either point experimentally.

My paper may have seemed more destructive than constructive, to which charge I plead guilty. While I do not feel that Dr. Sampson has demonstrated the correctness of his theory, I do not arbitrarily urge the correctness of the explanation which I have offered, and, indeed, there are many points which are far from clear on the basis of any explanation which has yet been suggested.

DR. JOHN A. SAMPSON (closing).—In my early studies of pelvic peritoneal endometriosis I believed that the endometrial tissue in these lesions arose from the implantation of bits of this tissue derived solely from the perforation of an endometrial cyst of the ovary and from the menstrual reaction of endometrial tissue on the surface of that organ. At that time I thought that the endometrial tissue in the ovary probably developed solely from its surface epithelial as described by Russell. Later I found that pelvic peritoneal endometriosis occurred without any demonstrable endometrial tissue in the ovary and naturally looked for another avenue by which bits of the uterine mucosa might gain access to the peritoneal cavity. I carefully examined the fallopian tubes of patients operated upon during the menstrual period and occasionally found blood escaping through their fimbriated ends. I thought, and still do think, that bits of endometrial tissue in this blood become implanted not only upon the peritoneum but also on the ovaries. While I have been very enthusiastic over the implantation of endometrial tissue from this source at no time have I been able to convince myself that it was the sole cause of endometrial tissue in the ovaries. The ovary differs from the pelvic peritoneum in that a variety of epithelial growths arise in it and it is natural to assume that potential müllerian tissue at times might be present.

I have frequently observed blood escaping through the fimbriated ends of the tubes after a preliminary curettage. I have found bits of the uterine mucosa in the lumen of sections of these tubes showing that unless it was there beforehand it readily passed through the interstitial portion of the tube and also, under certain circumstances, it takes but a very short time for blood containing bits of the uterine mucosa set free by curettage to escape from the uterine cavity out through the tubes into the peritoneal cavity.

I have found fragments of cancer lying free in the lumen of the tubes of patients with peritoneal carcinosis associated with a primary ovarian carcinoma. I believed that these fragments were drawn into the tube as described by Dr. Novak. While I have appreciated that fragments of endometrial tissue were set free into the peritoneal cavity through the perforation of an endometrial cyst of the ovary, and from the menstruation of endometrial tissue on the surface of that organ, it had not occurred to me that bits of this tissue also might be drawn into the lumen of the tube until Dr. Novak called my attention to it. I believe that it does occur. It adds interest to the problem and I had not studied my specimens from this standpoint. I am taking the liberty to add these notes to the discussion after reviewing my material on my return from the meeting.

In four instances in which blood was observed escaping from the tubes of patients operated upon during their menstrual period it was collected in a spoon by stripping the tubes from the uterus toward the fimbriated end. The blood was spread on slides, dried, fixed and stained by various methods. The method which was found to be the most satisfactory by Dr. L. A. Sutton who is associated with me, was to fix the slides in Zenker's solution and stain with hemotoxylin and eosin. Epithelium-like cells were found in these preparations and in some of them fragments of tissue resembling the stroma of the uterine mucosa. There are certain objections to the method. One is that the trauma of stripping the tubes may dislodge some of the tubal epithelium and the other is the difficulty we experienced in identifying the cells and tissue in these preparations. In none of these four cases was a peritoneal endometriosis present or any evident endometrial tissue on the surface of the ovaries. In four other cases one or both tubes were removed with the uterus. In the first case a peritoneal endometriosis was present and blood was observed escaping from both tubes on exposing the pelvic organs. The uterus, one tube and ovary were removed. Unfortunately, the fimbriated end of the tube was not ligated and most of the blood escaped from it during the manipulation during operation. Epithelium and tissue resembling endometrial stroma was found in the lumen of the tube and from the nature of the peritoneal lesions and that in the ovary I do not believe it could have been derived from these.

Case No. 2, the patient aged forty-four gave a history of very profuse menstruation and a previous curettage, with only temporary relief. The uterus was found to be irregularly enlarged and retroflexed. On exposing the pelvic organs at operation blood was observed escaping from both tubes. Two small pigmented blebs were present on the under surface of the left ovary and blood was not observed escaping from these. The fimbriated ends of both tubes were ligated. The uterus, left tube and ovary, and right tube were removed. This case was reported by me in a previous article (*Surg., Gyn. and Obst.*, March, 1924, p. 287). The two lantern slides shown by Dr. Novak were made from illustrations of this case in that article. Strips of epithelium were found in the lumen of the tube, one gland and also fragments of endometrial stroma, identical in their structure with those present in the mucosa of the uterus from which a large amount of tissue had been cast off by the menstrual reaction. The ovarian lesion consisted of two small cystic cavities lined by epithelium of endometrial type with very little stroma beneath it and no glands. In places a small amount of the epithelial lining had been cast off by an apparent menstrual reaction but not enough to account for that present in the tube nor did it resemble it as closely as did that in the uterus. I believe that the greater portion or all of the endometrial tissue in the tube must have come from the uterine cavity.

Case No. 3, the patient aged 49 gave a history of prolonged profuse menstruation. The uterus was enlarged due to a myoma. On exposing the pelvic organs at operation blood was observed escaping from both tubes. The fimbriated ends of both tubes were ligated. The left ovary was adherent by its lateral surface to the posterior surface of the uterus due to endometrial tissue on the surface of that organ. A small "patch" of endometrial tissue was present on the posterior surface of the uterus mesial to the left ovary. The uterus, both tubes and ovaries were removed. Small bits of endometrial tissue were found in sections of the tubes which were identical in their structure with fragments of the uterine mucosa present in sections of blood obtained from the uterine cavity. I cannot exclude the possibility that the bits of endometrial tissue in the tube in this case were not drawn into the tube from the endometrial tissue on the posterior surface of the uterus but from observations made at the operation it was evident that the blood in the tubes was coming from the uterine cavity.

Case No. 4, the patient gave a history of prolonged profuse menstruation due to a submucous myoma. On exposing the pelvic organs at operation blood was observed

escaping from both tubes. The fimbriated end of the left tube was ligated and the left tube and ovary and uterus were removed. A clump of epithelium-like cells was found in the lumen of the tube but no endometrial stroma. A mitotic figure was present in one of the cells. I was unable to find any mitotic figures in epithelial cells in the blood obtained from the uterine cavity.

There is no doubt in my mind that regurgitation of menstrual blood from the uterine cavity through the tubes does occur. I have seen blood dripping from the tube, and on squeezing the uterus have forced more out. Whether or not this causes the lesions of peritoneal endometriosis remains to be seen.

I wish to thank Dr. Novak for the friendly way in which he has attacked this subject. For the sake of the advancement of our knowledge of this subject I am glad he has taken the opposite side.

None of my patients had had a previous insufflation of the tube. I can readily see that if there is anything in the implantation theory that insufflation of the tube, if done at the wrong time, would contribute to the lesions.

Dr. Goodall's question refers, I think, to one of the most difficult problems we have in connection with this subject, that is, how to treat our patients where conservative surgery is desired. I firmly believe that removal of the ovaries will have the same effect on ectopic endometrial tissue as it does on the mucosa lining of the uterine cavity. I do think it is justifiable to do conservative surgery in women who are anxious to have children. Eight of my patients have become pregnant after conservative surgery. Usually the lesion is of slow growth and frequently does not give rise to any symptoms. If the patient is having disturbances from it and we do conservative surgery, it should be done with the understanding that we may have to resort to radical means later.

DR. ROBERT T. FRANK, NEW YORK CITY.—I have two parallel cases on which I would like to have some advice. In one I did an operation and cleared out the pelvis except the retrovaginal septum. I took out both ovaries, the patient recovered and has no pain. In another case, I did not open the abdomen but was sure the condition was present because it showed itself in polyposis of the vaginal vault. In this instance I thought the technical difficulties were so great that I used radium and x-ray. Atrophy occurred but the patient is still suffering from a great amount of pain. I wondered if Dr. Sampson had any method of treatment to offer for this condition?

DR. JOHN A. SAMPSON, ALBANY, N. Y.—I have no treatment to offer in these conditions. I have had cases very similar to the first one of Dr. Frank in which I have left behind a large amount of endometrial tissue in the pelvis after removing the uterus and both ovaries. In one instance marked obstruction of the sigmoid was present and I made a temporary colostomy. I found afterward that the endometrial tissue had cleared up to a great extent.

As to the influence of radium and x-ray, I took this up a year ago with Dr. Curtis F. Burnam and he informed me that radium would have no effect on misplaced endometrial tissue except as it would be influenced by the cessation of the function of the ovaries.

DR. EMIL NOVAK, BALTIMORE, MD.—My impression is that removal of the ovaries will ordinarily check further development of the endometrium. That, at any rate, has been my experience in a number of cases, and it is exactly what we should expect from our knowledge of the normal subservience of the endometrium to ovarian function.

DR. ROBERT T. FRANK, NEW YORK CITY.—The patient referred to has not menstruated. I am trying to contrast the two cases. Her pain which has been men-

tioned before is still present. The important thing is to determine whether roentgen castration can replace the technically difficult as well as dangerous complete operation of hysterectomy.

DR. EMIL NOVAK, BALTIMORE, MD.—I believe that radium will, through its action on the ovaries, ordinarily check further growth of endometrial tissue, but that it will have no good effect and may actually do harm in many cases, where there has been an extensive reaction produced by the growth of endometrium and where extensive adhesions are present.

DR. JOHN A. SAMPSON, ALBANY, N. Y.—You cannot tell what reaction radium might have on the other lesions. I would rather remove the ovary in those cases than use radium.

DR. N. SPROAT HEANEY, CHICAGO, ILL.—Dr. Goodall asks a question with which I have been confronted a number of times. I have had a few cases where the posterior surface of the uterus was as velvety as the lining of the uterus would be. Endometrial tissue was covering it up and making a velvety membrane, yet the patient was a young woman. Two or three very small millet seed sized implants might be found in the tube and in the round ligament, and these I treated by destroying those that were very fine with the cautery, then going over the back of the uterus with a flat cautery at low heat until the tissue as far as I could tell was thoroughly destroyed. I have not had a recurrence of the trouble yet, and two of those patients are pregnant. There might be difficulty, where there is a great deal of infiltration, to destroy them safely, but where they are superficial and thin it seems to me that this might be one method of destroying these endometrial grafts.

DR. WILLIAM C. DANFORTH, EVANSTON, ILL.—I had two instances of young women, twenty-three and twenty-four, in whom one ovary was taken out and the other was resected. One patient has had two successful pregnancies; the second become pregnant and aborted at the end of three months. Neither one has developed any subsequent trouble.

(As this issue of the Journal is given over to the Transactions of the American Gynecological Society, the usual special departments have been omitted, but their publication will be resumed in the November number.)

Books Received

VEIT'S HANDBUCH DER GYNAEKOLOGIE. Dritte Auflage herausgegeben von Professor Dr. W. Stoeckel, Berlin. Zweiter Band, mit 265 Abbildungen im Text. Verlag von J. F. Bergmann, Muenchen, 1926.

L'ESPLORAZIONE DELLE VIE URINAIRE nella patrica ostetrico-ginecologica. Dott. Carlo Colombino. Con 102 figure nel testo e 5 tavole a colori. Milano, L. F. Cogliati. 1926.

CLINICA OBSTETRICA, por Dr. Guillermo Liepman. Cuarta edicion, traducida por el Dr. Victor Conill y Montobbio, Barcelona. Salvat editores, Barcelona, 1926.

MANUAL OF PROCTOLOGY, by T. Chittenden Hill, Ph.B., M.D., F.A.C.S., instructor in proctology, Harvard Graduate School of Medicine, etc. Second edition, thoroughly revised. Illustrated with 101 engravings. Lea & Febiger, Philadelphia, 1926.

CLINICAL PEDIATRICS, by John Lovett Morse, professor of pediatrics, emerit. Harvard Medical School, etc. Illustrated. Philadelphia, W. B. Saunders Company, 1926.

INTERNATIONAL CLINICS. A quarterly of illustrated clinical lectures and especially prepared original articles, etc. Volume III, thirty-sixth series, 1926. Philadelphia, J. B. Lippincott Company, 1926.

BIRTH CONTROL AND THE STATE. A PLEA AND A FORECAST. By C. P. Blacker, M.C., M.A., M.R.C.S., L.R.C.P., New York, E. P. Dutton & Company, 1926.